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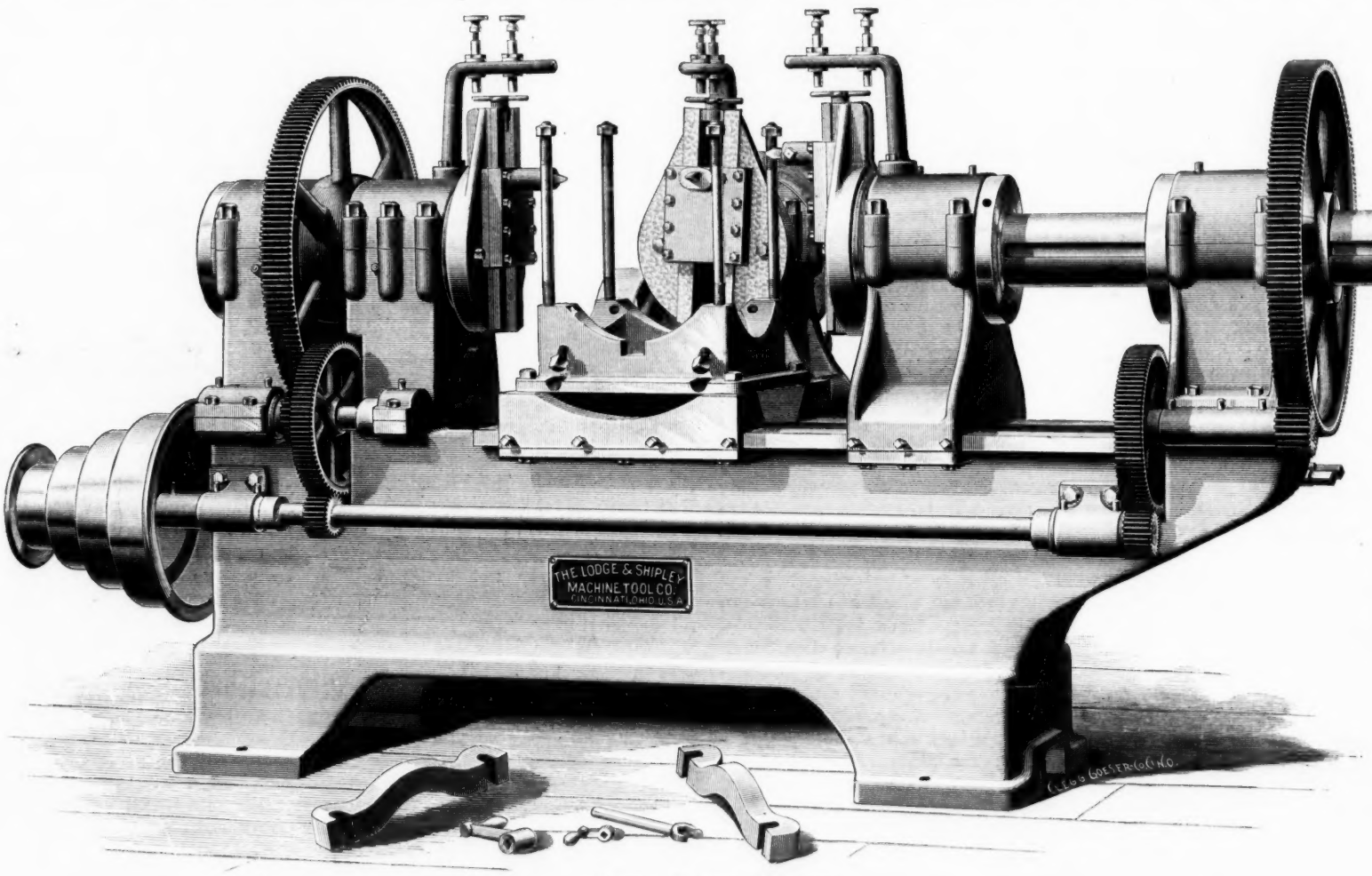
Triple Facing Machine.

This machine was designed for the purpose of facing flanged pipe fittings, and is so arranged that the three sides of a fitting may be operated on at one time. It is fitted with power feed in either direction, and will face up to 24 inches diameter. The facing head shown on the right is adjustable to and from the stationary head by means of a screw. The back facing head is also adjustable to and from the center by means of a screw. It is very powerfully geared, and large gears on spindles are 30 inches diameter. Cone pulley on driving shaft makes 30 revolutions while spindle makes one. Back facing head is run by means of a worm and worm-wheel; motion for this being derived from the gear train at the left. Geared as they are, the spindles all have the same rate of motion, and in setting up the machine they are placed not as the engraving shows them, *i. e.*, so that all the star feed wheels are at top at the same time, but so that the rear head never can interfere with the others during its revolution, when set forward to operate upon relatively small fittings. All spindles are 8½ inches in diameter, and are scraped to alignment in their journals, which are not babbitted.

Frame, including stationary head, is all one piece. To the carriage—upon which the chuck for holding work is mounted—is fitted the back facing head, which, by means of a screw, may be moved to and from the stationary head. Four chucks, similar to the one shown in the cut, are furnished with each machine, taking a range of flanged fittings from 4½ inches to 16 inches and facing flanges up to 24 inches diameter. Machine is furnished with shaft and all necessary wrenches for adjusting machine and chucks. Weight, 6,850 pounds. It is made by the Lodge & Shipley Machine Tool Co., Cincinnati, O.



TRIPLE FACING MACHINE.

With all large naval powers in Europe the possibility of an increase in the navy is a question of great importance. The cost of the army and navy is reducing many countries in Europe to a condition that is little better than one of bankruptcy, and this is telling on manufacture. However the cost may be temporarily distributed, it, of course, comes back to the producing classes, who must pay for it all. Agriculture in Europe is already taxed to its utmost, and the artisan must take up the burden. In this country the matter is, as yet, of little importance, because the expenditures are on a comparatively small scale. And it is likely they will be kept small, comparatively, for a good many years, possibly until a change comes over the whole matter. This change is likely to come through sheer exhaustion of the ability of European governments to stand the strain, and hence some kind of an understanding of what different countries shall be allowed to maintain in both army and navy. So far the construction of a navy in this country has hardly been disadvantageously felt, because the supplying of the material necessary for the purpose has developed the ability to manufacture for other purposes. But, of course, if the development goes on far enough it will be felt. The fact that the industry of this country is taxed much less for what cannot be looked upon otherwise than a useless purpose, is greatly in the interest of manufacture in the United States. It has this less burden to bear, and hence is freer to expand.

Ex-Congressman Otis is advocating and pushing a scheme in Kansas for reviving and perfecting co operation. There is something alluring in the idea of doing away with the army of middlemen that pervades every important enterprise or industry. But in these times of competition it is not easy to do so. It is not so much that middlemen are needed to make sales as to prevent the other fellow from selling. The profits of middlemen are very generally overestimated, and co-operation does not find so much of a margin for saving in cutting off their profits as is expected. Then those who enter into co-operation must buy and sell, and someone must be paid for doing this for them. Still, there is no doubt that in many instances there are too many between the producer and consumer, and one of the aims of co-operation is to reduce this number.

A daily paper mentions as rather remarkable that a new dredging machine will "cut her own flotation," by which is meant, as further explained, that it can make its own passage through a bank, if her channel is open to water. Just what a dredging machine would be good for that could not do this is not stated.

In France, when the government places a loan, the people subscribe directly for it. If there is any benefit from it, in the way of good interest, the people subscribing small sums get that benefit. In this country some sort of a syndicate or corporation gets the benefit, the people furnishing the money.

A committee of the Produce Exchange recently appeared before the Assembly and Senate at Albany, presenting an argument in favor of the improvement of the Erie Canal. This is in the line of good common sense. The Erie Canal is important, not only to the State of New York, but to the whole country.

Recent and apparently successful experiments in Paris tend to show that sewage can be rendered harmless—innocuous—by electricity, and that the process is a cheap one. If this is found to be true, an important end will have been gained.

Compressed Air Transmission.

BY FRANK RICHARDS.

The table following gives the actual volume of air transmitted by pipes of various sizes and at various velocities. As air in transmission soon attains the temperature of the pipe and its surroundings, its temperature need not generally be taken into account as affecting the volume. While in considering the operation of compression we base our computations upon the volume of *free air* compressed, it is better in transmission to

consider the actual volume of the air during transmission, or usually either at the beginning or at the completion of the transmission. The volume of free air transmitted may be assumed to be directly as the number of atmospheres to which the air is compressed. Thus, if the air transmitted be at 75 pounds gauge pressure, or six atmospheres, the volume of free air will be six times the amount given in the table. This table will be found handy in determining the size of pipe to be adopted for given cases of transmission. For comparing cases of transmission the linear velocity of flow is the more convenient form of statement. It is generally considered that for economical transmission the velocity in main pipes should not exceed 20 feet per second. In the smaller distributing pipes the velocity should be decidedly less than this.

TABLE OF THE VOLUME OF AIR TRANSMITTED IN CUBIC FEET PER MINUTE IN PIPES OF VARIOUS DIAMETERS.

VELOCITY OF FLOW.		DIAMETER OF PIPE IN INCHES.											
Feet per Second.	Feet per Minute.	1	2	3	4	5	6	8	10	12	16	20	24
1	60	.327	1.31	2.95	5.24	8.18	11.78	20 94	32.73	47.12	83.77	130 9	188 5
2	120	.655	2 62	5.89	10.47	16.36	23 56	41 89	65 45	94 25	167.5	261.8	377
3	180	.982	3.93	8.84	15.7	24.5	35.3	62 8	98.2	141.4	251.3	392.7	565.5
4	240	1 31	5.24	11.78	20.9	32 7	47.1	83 8	131	188	335	523	754
5	300	1 64	6.54	14.7	26.2	41	59	104	163	235	419	654	942
6	360	1.96	7.85	17.7	31.4	49.1	70.7	125	196	283	502	785	1,131
7	420	2 29	9 16	20 6	36.6	57.2	82.4	146	229	330	586	916	1,319
8	480	2 62	10 5	23.5	41.9	65 4	94	167	262	377	670	1,047	1,508
9	540	2 95	11.78	26.5	47	73	106	188	294	424	754	1,178	1,696
10	600	3.27	13.1	29.4	52	82	118	209	327	471	838	1.309	1.885
12	720	3.93	15.7	35.3	63	98	141	251	393	565	1 005	1,571	2,262
15	900	4 91	19 6	44 2	78	122	177	314	491	707	1,256	1,963	2 827
18	1,080	5 89	23.5	53	94	147	212	377	589	848	1,508	2,356	3,393
20	1,200	6 54	26.2	59	105	164	235	419	654	942	1,675	2,618	3,770
24	1,440	7.85	31.4	71	125	196	283	502	785	1,131	2,010	3,141	4.524
25	1,500	8.18	32.7	73	131	204	294	523	818	1,178	2,094	3,272	4,712
28	1,680	9 16	36.6	82	146	229	330	586	916	1,319	2,346	3,665	5,278
30	1,800	9.8	39.3	88	157	245	353	628	982	1,414	2,513	3,927	5,655

Compressed air has usually to be transmitted a greater or less distance from the compressor to the place where it is used, and in computing the cost or economy of operations in which compressed air is employed, it becomes necessary to consider the friction of the air in the pipes and the power lost in overcoming it. It is probable that in the minds of most persons who have not investigated the matter this loss has been greatly exaggerated. It seems certain that power may be transmitted by compressed air for considerable distances with less loss than by any other means. We can't do anything for nothing, and, of course, there is some loss of power in the transmission of compressed air, but in general practice thus far, unless the piping system has been outrageously bad and inadequate, the losses by transmission have not been worth considering. The distances traversed have usually not been great enough to make the loss a serious one, or at all to be compared with the losses of power in the operation of compression and in the re-expansion or final application of the air. But as compressed air practice develops, we want longer lines, and then the question of transmission rises to greater importance. We want to convey air long distances for the purpose of employing unused and now worthless water powers. We want long lines of piping for supplying street cars and for the general distribution of power in large cities. We want to convey natural gas from the wells where it flows, to towns and cities where it may be used to best advantage.

When we come to look up the formulas to depend upon for our computations, we don't find any that are satisfactory and reliable. The best that may be said of the best of them, and that with caution, is that they are approximately correct, but we know that they are in error in some particulars. The statements of actually observed facts in this line are in a more or less chaotic state, inconsistent and self-evidently unreliable.

It is, perhaps, too much to expect that close accuracy can ever be attained in these computations. There are too many factors in the case, and a little variation in any one may make a great difference in the result. A statement of the friction of air flowing through a pipe involves at least all the following factors: unit of time, volume of air, pressure of air, diameter of pipe, length of pipe, and the difference of pressure at the ends of the pipe or the head required to maintain the flow. Neither of these factors can be allowed its independent and absolute value, but is subject to modifications in deference to its associates. The flow of air being assumed to be uniform at the entrance to the pipe the volume and flow are not uniform after that. As the air may be said to carry in itself its own means of propulsion, some of which it is using as it goes along, it is constantly losing some of its pressure, and its volume is constantly increasing. The velocity of flow is therefore also somewhat accelerated continually. This also modifies the use of the length of the pipe as a constant factor. It would be very natural to assume that if a certain head were sufficient to maintain a certain flow for a given length of pipe that double the head would be sufficient for double the length. But that could not be so, for in the second length all the head that propelled the air through the first length has been lost, and the volume is now greater through the loss of that pressure, and the velocity is greater, and it will require more additional head for the second length than was required for the first. So of the other important factor, the diameter of the pipe. The actual area or apparent capacity of the pipe is, of course, directly as the square of the diameter, but the volume of air transmitted for given length and head will not be in any such ratio. The surface resistance is proportionately much greater in the smaller pipes. While the area is as the square of the diameter the periphery is directly as the diameter. Also, the greatest distance of any portion of the air from the periphery being less in the smaller pipe the viscosity of the air counts for more. For volumes in proportion to the areas of the pipes a 1 inch pipe will require for any given length more than three times as much head as a 2-inch pipe.

Then, besides the fluctuating values of these fickle factors there is that other factor, unrecognized in our computations, but arrogantly assertive in practice, the condition of the pipe itself. The actual diameter of the pipe, especially in the smaller sizes, is different from the nominal diameter. Some pipe is smooth and some has seams and blisters. The pipe may be straight or it may be crooked and have numerous elbows. Everybody knows that elbows have to be settled with. There is in one of the catalogues a copyrighted table of the resistances of elbows, from which I gather that eight or ten 1-inch elbows are equal to one length of pipe, so that *if the table is to be relied upon* the elbows are not as obstructive as they are popularly supposed to be. I would rather consider one elbow as equivalent to a length of pipe.

Under the circumstances I do not wish at present to offer any working formula for the friction of air in pipes. The table below is believed to be tolerably correct and reliable as far as it goes. A table covering all the pressures and conditions in common practice would be too voluminous to offer here:

TABLE OF HEAD OR ADDITIONAL PRESSURE REQUIRED TO DELIVER AIR AT 75 POUNDS GAUGE PRESSURE THROUGH PIPES OF VARIOUS SIZES AND LENGTHS.

1″ PIPE.

Length of Pipe in Ft.		50	100	150	200	300	500	1,000
Cubic ft. of free air per min.	25	.245	49	.735	.98	1 47	2.45	4.9
	50	.981	1.962	2.943	3 924	5.886	9.81	.....
	100	3.925	7.85	11 77	15.7	.....	.....	.....
	150	8.829	17.66	...	..	.....	....	.....

1¼″ PIPE.

Length of Pipe in Ft.		50	100	150	200	300	500	1,000
Cubic ft. of free air per min.	25	.056	112	168	.224	.336	.561	1.123
	50	224	.449	.673	.897	1 35	2.21	4.49
	100	897	1.79	2 69	3 59	5.38	8.97	.....
	150	2.02	3.94	6 06	8.07	12 11	.....	.....
	200	3.59	7.18	14.36	....	.....	.....	.....

1½″ PIPE.

Length of Pipe in Ft.		50	100	150	200	300	500	1,000
Cubic ft. of free air per min.	25	017	.034	.051	.068	.103	.171	.342
	50	.068	.137	.205	.274	.411	685	1 37
	100	.274	.548	.822	1.09	1.64	2 74	5.48
	150	616	1 23	1 85	2 46	3.69	6.16	12.33
	200	1 09	2.19	3 29	4 38	6.57	10.96	21.9

2″ PIPE.

Length of Pipe in Ft.		50	100	150	200	300	500	1,000
Cubic ft. of free air per min.	50	.019	038	.057	076	.114	.19	.381
	100	076	.152	.228	.304	.457	.761	1.52
	150	.171	.343	.514	.685	1.03	1.71	3.44
	200	304	.609	913	1 22	1.83	3 04	6.09
	250	476	952	1 43	1.9	2 86	4.76	9.58
	300	.685	1.37	2 05	2.74	4.11	6 85	13.72

2½″ PIPE.

Length of Pipe in Ft.		100	200	300	400	500	1,000	2,000
Cubic ft. of free air per min.	100	.043	.087	.13	.174	.217	.434	.868
	200	.174	.347	.521	.694	86	1 74	3 47
	300	.39	.781	1 17	1 56	1 95	3.91	7 81
	400	694	1 39	2 08	2 78	3.47	6.94	13.89
	500	1.08	2 17	3.25	4.34	5 42	10 85	21.7

3″ PIPE.

Length of Pipe in Ft		100	200	300	400	500	1,000	2,000
Cubic ft. of free air per min.	100	0166	.0333	.05	.0666	.0833	.166	.333
	200	.0666	133	.2	266	.333	.666	1.333
	300	.15	3	.45	.6	.75	1.5	3.
	400	.266	.533	.8	.106	1 33	2.66	5 33
	500	416	833	1.25	1.66	2 08	4.16	8 33

3½′ PIPE.

Length of Pipe in Ft.		100	200	300	400	500	1,000	2,000
Cubic ft. of free air per min.	250	.0416	.0832	.125	.166	.208	.416	.832
	500	.166	.332	.499	665	.832	1 66	3.32
	750	.374	.748	1.12	1.69	1.87	3 75	7.49
	1,000	.665	1.328	1.99	2.66	3.33	6.66	13.3
	1,250	1.04	2.08	3.12	4 15	5.2	10.4	20.8

4″ PIPE.

Length of Pipe in Ft.		100	200	300	400	500	1,000	2,000
Cubic ft. of free air per min.	500	.08	.16	24	.32	.4	.8	1.6
	750	.18	.36	.54	.72	.9	1 8	3.6
	1,000	.32	.64	.96	1.28	1 6	3.2	6 4
	1,250	.5	1.	1.5	2	2.5	5.	10.
	1,500	.72	1.44	2.16	2.88	3.6	7.2	14 4

5″ PIPE.

Length of Pipe in Feet.		500	1,000	2,000	3,000	4,000	5,000
Cubic ft. of free air per min.	500	.11	.22	.44	.66	.88	1.1
	1,000	.44	.881	1.76	2 64	3.52	4 4
	1,500	.99	1.98	3 96	5 94	7.92	9.9
	2,000	1 76	3.52	7 04	10.56	14.08	.....
	2,500	2.75	5.5	11.	16 5	.....	.....

6′ PIPE.

Length of Pipe in Feet.		1,000	2,000	3,000	4,000	5,000	10,000
Cubic ft. of free air per min.	1,000	.354	.708	1 06	1 42	1.77	3 54
	1,500	.799	1 599	2 4	3.2	3.99	7.99
	2 000	1.417	2.83	4 25	5 67	7 09	14.17
	2 500	2 22	4.44	6 66	8 89	11 1	.....
	3,000	3 18	6.37	9 5	12.7	15.9	.....

8″ PIPE.

Length of Pipe in Feet.		2,000	4,000	6,000	8,000	10,000	15,000
Cubic ft. of free air per min.	2,000	.598	1.19	1.79	2.39	2.99	4 48
	2,500	.935	1.87	2.81	3.74	4 68	7.02
	3,000	1 25	2.49	3 74	4.99	6 24	9.36
	4,000	2 39	4.79	7 18	9.58	11 97	.....
	5,000	3 74	7.48	11.23	14 97	18.71	....

10″ PIPE.

Length of Pipe in Feet.		2,000	4,000	6,000	8,000	10,000	15,000
Cubic ft. of free air per min.	2,500	.286	.57	.86	1.14	1.43	2 15
	5,000	1.14	2.29	3.43	4 57	5 71	8 56
	7,500	2.57	5 15	7.72	10.29	12 86	..
	10,000	4.57	9 14	13.7	.....	.....	.....

12″ PIPE.

Length of Pipe in Feet.		2,000	4,000	6,000	8,000	10,000	20,000
Cubic ft. of free air per min.	2,500	.11	.22	.33	.44	.55	1.101
	5,000	.44	.88	1 32	1.76	2.2	4 4
	7,500	99	1 98	2.97	3 96	4.95	9 91
	10,000	1 76	3 52	5.28	7 05	8.81	17.6

Chimneys.

BY WILLIAM BARNET LE VAN.

Chimneys are like mules—past finding out. A mule will kick when he might be expected to be docile, and *vice versa*. So a chimney will show a draught when there is no fire passing into it, and when fire is turned into it it sometimes doesn't "draw" worth a cent. The why of this passes my comprehension. The phenomena pertaining to chimneys have been well discussed in the last few years by engineers, and very little light has been thrown on the subject. The element of position has a great influence upon the draught, subordinate only to the height of the chimney. Chimneys of about one hundred feet high often prove troublesome, and the cause is a difficult one to arrive at.

In my opinion the majority of our chimneys are too large for the amount of hot gases entering them. When the area of the chimney is much larger than the aggregate area of the flues entering it, the diminution of friction and the expansion of hot gases into a larger area are favorable for the improvement of the draught, but the velocity of the ascent of the heated gases may be very much diminished, and in some cases—where the ascending current does not fill the chimney, so to speak—downward currents of air will be produced to the impairment of the draught.

In a chimney that will maintain a water column of one-half inch in height, there will be no difficulty in keeping a good fire on the grates without the use of the slicing bar. In certain states of the atmosphere, the fires do not burn briskly, although the water gauge shows a good draught and the usual quantity of air is supplied. The air appears to be comparatively quiescent in the chimney when in fact the wind is blowing, especially in the summer when the wind is from the south; this is hard to account for, and with a north or westerly wind the fires exhibit the effect of a current. But the direction of the wind is not always a guide, nor can it be expected to be, since at times it blows in "whirls," and its direction may be from the south at one height and from the northwest higher up, yet a northwest wind, according to my observation, always causes a good draught.

For large steam power plants the most important factor for producing steam economically is the chimney, for on it we depend for the proper combustion of the fuel, and without intense draught perfect combustion cannot be accomplished. The intensity of draught is, however, independent of the size of the chimney, and depends upon the difference in weight of the outside and inside columns of air. This is usually stated in an equivalent column of water, and may vary from zero (0) to possibly two inches in height. It varies directly with the product of the height into the difference of temperature.

The intensity of draught required varies with the kind and condition of the fuel and the thickness of the fires. Wood requires the least, and fine coal the most. To burn the latter to advantage a draught of about one to one and one-quarter inch column of water is necessary, which can be obtained by a well-proportioned chimney, 150 to 200 feet high.

A rapid draught in one respect is equivalent to a large fire grate area (the higher the chimney the less area of grate will be required), since they both enable more fuel to be burned in a given time, and thus increase the power of the boiler in generating steam. A quick draught, however, has this advantage, that, inasmuch as the temperature of the furnace is higher when the same quantity of heat is generated in a small space, than it will be when generated in a large space, the heat is transmitted much more rapidly to the water of the boiler in the case of the strong draught, by reason of the higher temperature thus obtained. As there is more heat transmitted in the region of the furnace, in the case of the strong draught, there will be less remaining

to be transmitted in the region of the flues; or, in other words, the flues will have less work to do, and they may either be made shorter, or the heat will be more thoroughly absorbed. A low fire is never economical; the same quantity of *fuel* burnt at a *high* temperature would do more work. A chemist will get *fourteen pounds* of water turned into steam by one pound of carbon; but in engineering the best result that can be attained is *twelve pounds of water* by one pound of carbon.

Large flues absorb more heat than small ones, as both the volume and intensity of the heat are greater with equal surfaces. This shows the importance of having a high chimney, in order that smaller flues can be used to produce the same result as larger ones with a corresponding less height of chimney.

A great many engineers express a doubt as to the necessity of very great height in chimneys. They claim a loss of heat from radiation, together with the increased resistance experienced in long flues, has caused designers of chimneys, in many cases, to build them of less height and greater sectional area than formerly, thus reducing the velocity of the ascending currents. But in cases where the gases have to be drawn through long or contracted flues before reaching the main shaft, however, a tall chimney is almost indispensable, in order to obtain the requisite exhaust and in such cases the loss from radiation must be reduced as much as possible by an increase in the thickness of the brickwork, when built of bricks, to guard against leakage, or if of iron, lined with brickwork to prevent excess of radiation.

The power-producing plants of modern times necessitate the erection of high chimneys, so as to enable them to burn more, and a cheaper fuel in a given space and time, and thus increase the power and lessen the cost of the latter.

Machine Shop Milling Practice—VII.

By Horace L. Arnold.

The statement so often made that in all cases where accurate surfaces were demanded the final machine cut was made, not by milling but by planing, can now be positively contradicted. The Pratt & Whitney Company recently milled thirteen 13″ engine lathe beds on their large "No. 7" slabber, and the result, notwithstanding the ominous numerical coincidence of name and number of pieces milled (13″ lathe beds and 13 of them), was of the most gratifying sort to those who maintain the cause of the milling machine as against the planer. These lathe beds were finished with three mill cuts; a back-and-forth rough milling operation, two cuts without changing anything, the second rough cut merely taking what the spring of the mill arbor left in the first cut, and bringing the milled surfaces to within about $\frac{1}{64}$″ on a side of finished dimensions. The roughing cuts were made first on all 13 beds in a lot; then the gang of mills was changed for the finishing gang, which were as near perfection as the most careful grinding by the Pratt & Whitney "patent relief" method could produce. The rough milled beds were put on the milling-machine table, one at a time, of course, and carefully "papered up" to a perfect bearing on the under side; this papering between the under side of the lathe bed and the machine table would have had to be done on the planer same as on the milling machine; that it was carefully and well done was fully proved by the perfect straightness and entire absence of "wind" in the finished work, which gauged perfectly for width at all points and was considered superior to any planed lathe bed produced in these shops, where the planing is undoubtedly as accurate as it is anywhere. The most careful tests with parallel pieces and a swinging straight-edge, failed to disclose any "wind" or twist whatever in any bed of the lot, and this single experiment fully disproves the statement so freely made both in the columns of the American Machinist and in machine shops generally, that no large surfaces can be so accurately finished by milling as by planing. And it must be borne in mind that these lathe beds were made with a gang of axial or side mills, which are, as is well known, not so perfectly adapted to the production of true surfaces as radial or end mills, and I feel fully warranted in saying here that milled work on surfaces of any dimensions *may* be produced in such perfection as to be incapable of improvement by hand scraping, and I do not think a very long time will pass before I am able to give a practical example which will prove the truth of my assertion, wholly improbable or even impossible, as it will doubtless be pronounced by those who are familiar with axial mill cuts only. The fact that the action of the radial or end mill exerts no more pressure on the work than that required to make a hand scraper of the same sharpness and width cut the metal, has never been given due consideration in milling operations, and it is perfectly clear to me that given a milling machine bed in contact with straight ways on which the bed runs, it is within the powers of the radial mill to produce work, not, of course, "optically" perfect, but which will bear the most rigorous machine tests for accuracy, and I fully expect to see such machines used, and their product put direct into the highest class of machine tools, without hand-scraping, before I cease to be interested in machine shop practice.

The gang of mills which finished these 13″ lathe beds were 6″ diameter, with 12 teeth, and were driven 15 revolutions, with 1 inch feed per minute, giving the following results:

Surface speed of mills.	23½ feet.
Cuts per inch	180.
Feed per tooth	0.00555 +
Feed per minute	1.000″

The cut was made *with* the revolution of the cutters, the "new" way, and, as will be noted, the surface speed was only a little over one-half that of the mills on the rack-cutting job (American Machinist, February 8, 1894), while the feed was almost exactly 7 times as great per tooth on the lathe bed as on the rack teeth, while both were what might be fairly ranked as perfect in quality of work produced. Placing the two side by side the factors of production are as follows:

Lathe Bed Cut—Feed with Rev. of Mill.	Rack Tooth Cut—Feed Against Rev. of Mill.
Surface speed 23½ feet.	44 feet.
Feed per minute 1.000″	1.750″
Cuts per inch 180	1,188
Cut per tooth 0.0055″ +	0.00084″ +
Depth of cut about 0.03125″	0.2″ +

The mills in one case ran at twice the speed of the other, and the deep cut was made at the high speed, and was nearly seven times the depth of the light cut, which is entirely contrary to theory, which says the lighter the cut the quicker the possible economical surface speed; the cuts per inch were 180 for the light cut, against 1,188 for the deep cut, or again about seven times as many cuts per inch for the deep cut as for the light cut, which *agrees* with theory and with lathe and planer practice, and both of the jobs are satisfactory, and the rack job as it stands is the result of 20 years' contract experience, where the workman has been directly interested in forcing production to its highest limit. It will be noted that the cut per tooth is among the largest, if not the very greatest, of any example given, which also, of course, accords with the best planer practice of finishing with a light cut and coarse feed; the very great disproportion in the number of cuts per inch, 180 for the light cut, and 1,188 for the deep cut, is at first sight surprising, although the same case has been noted before by a writer in these columns, who found a fine tooth high speed old-fashioned change gear-cutting mill, doing more work than he could possibly get out of his own coarse-tooth "patent-relieved" mills, which were believed to be the superior tools. See Mr. J. M. Lynch, January 11, 1894.

In the foregoing comparison the "depth of cut" line is misleading; the depth of cut on the lathe bed was about $\frac{1}{64}$″, while the depth of the cut on the racks was $\frac{2}{100}$″, the *thickness of the chip* on the lathe bed was $\frac{1}{64}$, while on the racks it was only 0.00084″ +, or only about $\frac{1}{4}$ the depth of the lathe bed cut, so that *really* the mills for the racks ran at, say, double the speed of the bed mills, and each tooth took a chip only $\frac{1}{4}$ the thickness of the slower speed mill teeth, which is a rational condition. Indeed, it would be hardly possible to find irrational or inharmonious results in two equally successful examples of practice, however much they might seem to differ at first sight, as the actual displacement of metal by cutting tools of the same angle is an operation of fixed conditions and possibilities, and the extreme limit will, I have no doubt, be found in all cases to lie at about the same point when all the modifying influences are rated at their real effective value. The seeming discrepancies lie in the obscurity of some of these conditions.

Before leaving the matter of the 13″ lathe beds it may be remarked that notwithstanding the great care with which the mills were made and mounted they did not cut uniformly all round, and, as nearly as could be seen, no two of them cut with same number of their teeth; some of them did not seem to touch the metal with more than 6 of the 12, while others would miss 2 or 3 or 4 in succession.

Fig. 38.

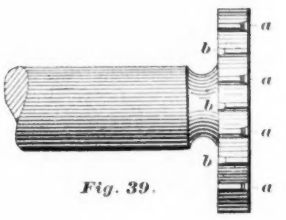


Fig. 39.

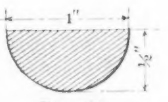


Fig. 40.

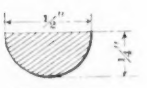


Fig. 41.

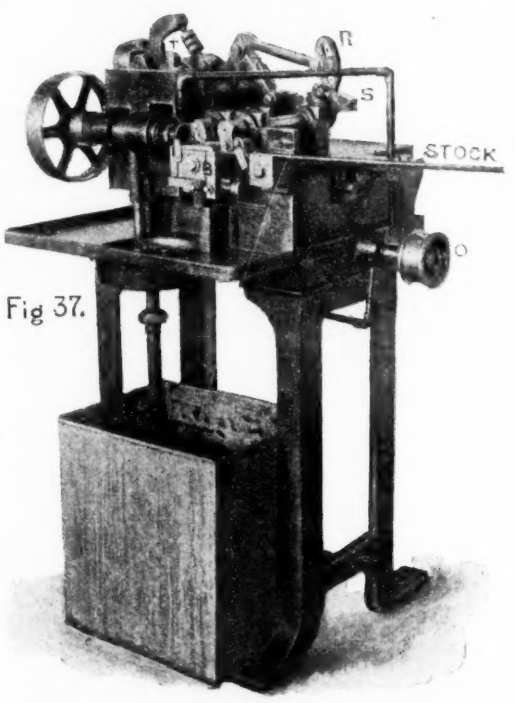


Fig 37.

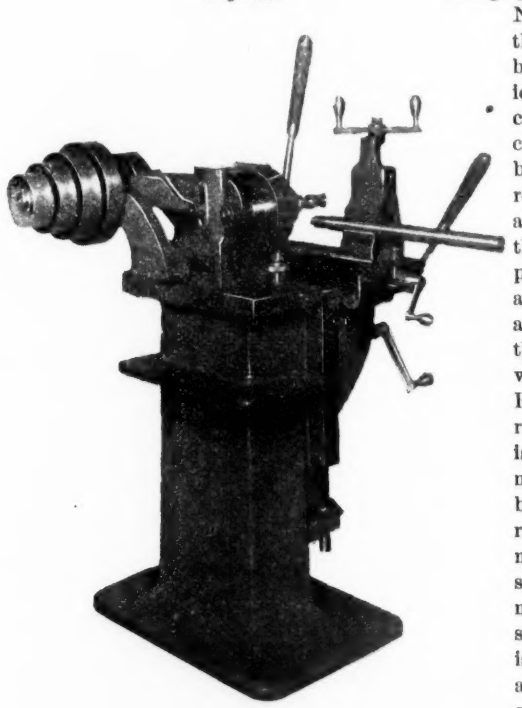


Fig. 42.

No doubt Mr. John A. McGregor is quite correct in saying that no work should be carried from the milling machine to the surface grinder with $\frac{1}{32}$″ "wind" in it. I merely repeat what I was told by the grinder, who was positive in his statements, and when I questioned the possibility of removing such large cuts at one passage of the wheel, so large as $\frac{1}{32}$″, he said that he took the most of it the first cut, and left as nearly a uniform cut for the finish as possible. And there is no question as to the impropriety of a large part of the finished surfaces which New England manufacturers put on their work. It is a relic of the barbaric taste for useless ornament and idle toil which survives in needlessly curved legs for tools, and in some cases yet, in crooked pulley arms, and bright work for mere display. The really good designer will carefully arrange his surfaces so as to leave all the unbroken skin of cast iron parts possible, finishing only isolated rings and spots and seats for applied parts, and thus avoiding the disturbance of the surface members of his work which resist internal initial strains. Regarding needless finish, I may here recall the polished and oil-stone finished *frames* of three gun-stocking machines built many long years ago by the Ames Co., at Chicopee, if I remember correctly, to go to the arsenal at Woolwich, Eng., and constructed at an expense of some $3,000 more than the contract price, just to show we knew how to do "real finished work." And this fancy, absurd as it seems to those who consider the real object and use of machine tools, still shows its influence on the work of some of the best New England constructors.

Fig. 37 shows the automatic milling machine used by the Woodruff Mfg. Co. to cut the Woodruff keys from half-round bars of drawn steel. The stock is automatically fed into the machine by a drag link operated by a rocker arm *R*, having a fixed over-travel conveyed to the drag-link rock-shaft through a spring arm *s*, so that when the inner end of the bar of stock reaches the stop gauge the spring at *s* yields to the over travel of the arm *R*. A micrometer adjustment of the gauge block *B* renders an exact stop location easy, and the stock passes under a hold down plate, reaching close to the cutters, and is held down by a roll on a short rocker arm while the cut is in progress. This hold-down, aided by the uniform section of the drawn stock from which the keys are cut, is so effective that there is no waste of stock, one bar acting as a feeder for the short end of the next, and only wasting the final remnant of a bar which is less in length than the thickness of the keys being cut at the time. The cutter spindle is carried by the large spring-balanced slide at the rear and left, which has a fixed vertical travel given by a rack and segment of gear shown at *f*.

To avoid waste of stock, the cutters or circular saws for cutting off the semi-circular pieces of steel which form the well-

known "Woodruff" machine key (of which the Pratt & Whitney Co. use 20 000 and F. E Reed the lathe maker, 15 000 yearly, making 35 000 per annum for these two users alone) were made as thin as possible, and to avoid cost of cutters the shanks were made small as possible to reduce the cost of manufacture of cutters by keeping the diameter down. These considerations led to the following cutter dimensions, the general form of the cutters being shown by Fig. 38.

Diam. Cutter.	Diam. Stem.	Thickness.
2″	$\frac{3}{4}$″	$\frac{3}{32}$″
1¾	$\frac{5}{8}$	$\frac{5}{64}$
1½	$\frac{3}{8}$	$\frac{1}{16}$

Cutters with such small shanks and thin bodies require, of course, an excellent machine for their use; nothing less than the best of support renders their successful use possible, and the writer, who designed these machines, takes great pride in their efficiency. The teeth of these cutters are spaced about $\frac{5}{32}$″ pitch, and the feed per tooth was fixed by experience with heavier cutters at $\frac{1\frac{1}{2}}{1{,}000}$ in. per tooth, which proved to be nearly three times too great, the feed in actual use being between $\frac{1}{2000}$″ and $\frac{1}{3000}$″ per tooth The work produced is extremely good, the variation in thickness of the keys as cut off being *less* than $\frac{9}{10000}$″, and the cut surfaces being very smooth—they might be said to be polished.

When first tried, however, with the cutter teeth of the ordinary form, ground square on top, these mills would not turn off any work to mention, and the surface left by their action was full of deep scratches. This was due to the fact that a chip cut out of the solid, as by a mill working in a keyway, for instance, is longer than the width of the tooth that cuts it, and has to be upset or crowded together on itself in order to pass out of the mill cut. As soon as the cause of the trouble was found to be in this before unsuspected fullness of length of chip, it was obviated by stoning off the corners of alternate teeth on opposite sides of the cutter, so that each tooth, instead of cutting the full width of the mill cut, cut only part of that width, one tooth cutting short on one side of the cut, and the next tooth cutting short on the other side of the cut as shown in Fig. 39, at *a*—*b*. All flat mill teeth working in deep cuts make the chip wider than the tooth, and the rough appearance of the walls of such cuts is due to the dragging out of this wide chip through a groove too narrow to admit of its free passage, and all such cutters would be greatly improved in action by having alternate corners stoned off, as shown in Fig. 39, though I have never seen it done except in this one instance. The chips measured a full $\frac{1}{1000}$″ more in length than the cutter width which produced them, and no headway could be made cutting off the keys until this defect was remedied.

The surface speed of these cutters is about 48 feet per minute; the cut is flooded by the oil pump seen at *O*, Fig. 37. The cutter slide is rack and pinion driven, and the cam shaft is worm driven; the cutters give no trouble by breakages, and their endurance is unexpectedly great—4,700 1″ keys giving a cut for each of the dimensions shown in Fig. 40 having been cut for once grinding, and 12,200 of the ½″ keys shown in Fig. 41.

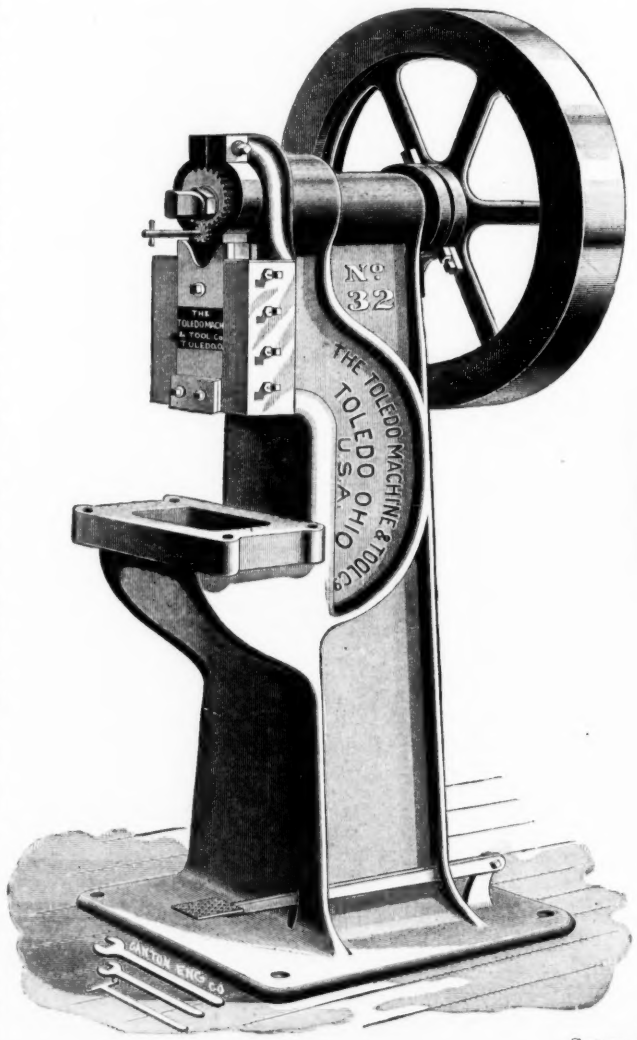
The production per day—with no attendance, except to put in the full length bars of stock as needed—is as follows, three different travels of cutter slide being used on different machines, each machine working three sizes of stock:

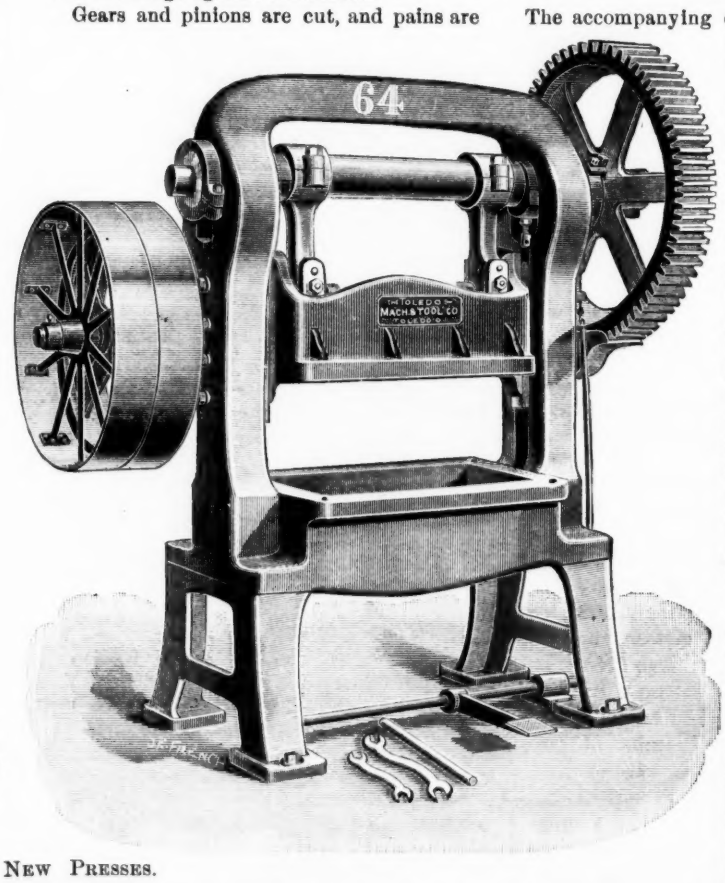
Small keys..... ⅛″, ⅝, ¾ long, 1,220 per day,
Medium ..... ⅜″, 1, 1⅛ long, 740 per day,
Large .... 1¼′, 1⅜, 1½ long, 480 per day.

Fig. 42 shows the improved hand keyseat sinking machine, furnished by the Woodruff Mfg. Co., for making the sinking cuts in which the Woodruff key is inserted. The cutter spindle is carried at the end of a radius lever journaled on the cone shaft center, thus giving a lever drop to the mill spindle with a uniform belt length; this drop is effected by the high hand lever; the radius lever is accurately balanced, and thoroughly supported between two substantial cheek plates, solid with the head casting, and means are supplied by which the radius lever may be instantly and rigidly clamped to these cheek pieces, thus giving a stationary cutter spindle. The work is held either in the vise or on the work table, and the work table is fed lengthwise by either a screw or by a hand lever pinion, as desired; and the knee has a screw adjustment vertically, while a tool shelf is placed on the column.

The perfect balance of the radius spindle lever and the hand lever feed for the same, make a sensitive hand action, and the whole machine is admirably adapted for many small milling operations, besides key seating for either the "Woodruff" or common flat keys. In addition to the "Woodruff" keys, the Woodruff Co. are now putting in a plant to produce common flat keys, which are to be within a thousandth gauge limit, tapers ½″, $\frac{3}{16}$″ and ¼″ to the foot, with ¼″ taper standard, either plain or gib ended. It is their intention to produce perfect polished keys in all sizes, up to 1″ wide and carry them constantly in stock, they believing that as soon as a key which is close to size can be bought cheaply, the users will make keyways to fit, and thus insure a large trade. It would seem that no one could afford to make their own keys when these flat keys are on sale.

Referring to the statement of production of keys with once grinding of cutter, it will be seen that the mills in making 12,200 small keys cut 2 413¾ square inches of steel, and in cutting the large keys the surface covered is 50 per cent. greater, or 3,691¼ square inches. These are, I believe, top records only, and probably indicate an individual and unusual endurance on the part of the large cutter.





Some New Presses.

Double Pitman Power Press—New Punch Press.

We illustrate below a machine which fairly represents a line of similar machines built by the Toledo Machine and Tool Co., Toledo, Ohio. Six different sizes of them are built, ranging from 30″ to 60″ between uprights, and both a light and a heavy pattern of each size are made, the engraving representing the lighter pattern.

The frame is made of box section, and is straight from the bed to the bearings of the crank-shaft.

The guides are very long, extending, in fact, below the bottom of the slide proper, as shown by the engraving.

The adjustments are such that parallelism is assured, and the adjusting devices are especially substantial, so that an adjustment once made is retained. The connections are made from steel castings, and have their bearings against solid metal.

Gears and pinions are cut, and pains are taken to secure a smooth and accurate working machine.

The engraving at the left is of a new punch press manufactured by the same concern. Several sizes of the machine are made; the engraving representing the No. 32 which weighs about 2,000 pounds.

In designing the machine, the object has been to combine the greatest possible strength and rigidity with convenience of operation for the class of work for which they are intended.

The pitman or slide connection is made from steel, and rests with its lower end on a solid seat in the slide. No strain is therefore brought to bear on the screw, except when bringing the slide up, the top end of pitman being slotted and gripped. The eccentric adjustment is operated by a pinion which insures rapid and accurate adjustment.

The crank-pin runs in a hard bronze bushing which can be replaced at small cost when worn out.

The automatic clutch mechanism is so constructed as to allow the shaft to be turned for setting dies while the wheel is in motion without endangering the operator. The press cannot be started unless stroke or slide of press is up. A new lock (not shown) has been provided which engages into the treadle, rendering it impossible to start the press by any accidental pressure upon the treadle. The lock is self acting.

The clutch mechanism is so constructed that when the operator has thrown off the belt the press can be worked in either direction, which is often very desirable when punches become stuck in the dies. The shafts are extra long and are made from forged steel. The clutch pins are forged from best cast steel for this purpose. The slide bearings are extra long, fitted to place by scraping and provided with gib adjustment for taking up wear.

Some New Forms of Roots Blowers.

The accompanying engravings are cross-sections of Roots blowers, showing two of the latest forms of impellers adopted by the P. H. & F. M. Roots Co., of Connersville, Indiana.

Fig. 1 is called the "standard" form of impeller, which is best adapted to light pressures—cupola and forge work, forced draught under boilers, exhausting dust from grinding rooms, or tumbling barrels, ventilation of buildings, glass works, and for supplying air to all kinds of small furnaces.

The builders state that the contact between impellers of this form is absolutely even and uniform throughout the entire revolution, and that there is therefore no possible escape of air backwards as with other forms of impellers. The shafts are twice as heavy as those formerly used, thus insuring rigidity and smooth operation.

Fig. 2 is a new form which is called the "true circle" form of impeller. It is best adapted to heavy pressures, pneumatic tube work, etc. The builders state that they formerly made an impeller of wood similar to this, but that in constructing it of iron a new formula is used to lay off the curves of the impeller in order to accomplish certain results that could not be obtained with the old form. They state also that this blower has been thoroughly tested under pressure, and has given excellent satisfaction, working practically noiselessly. The entire sur-

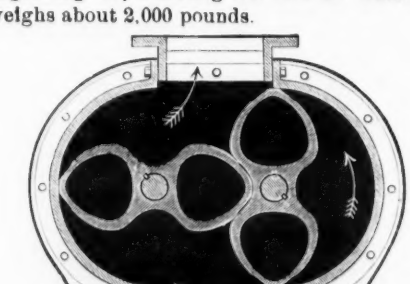


Fig. 1.

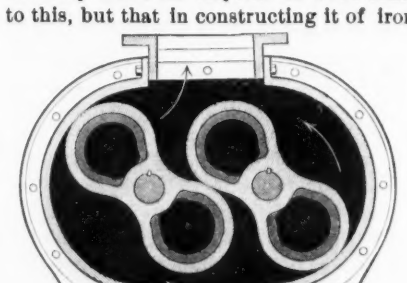


Fig. 2.

New Forms of Roots Blowers.

face of the impellers is finished on specially constructed machinery, thus securing uniform contact and reducing leakage to the minimum; and any size shaft necessary for the work to be done can be put in, and all shafts are pressed into the impellers by a hydraulic press.

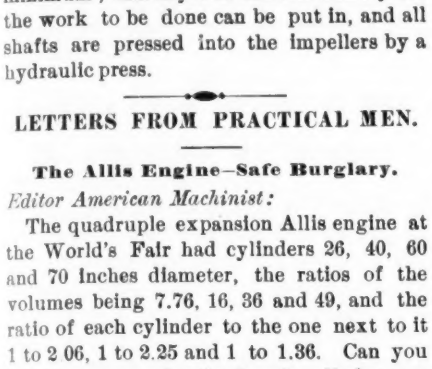
LETTERS FROM PRACTICAL MEN.

The Allis Engine—Safe Burglary.

Editor American Machinist:

The quadruple expansion Allis engine at the World's Fair had cylinders 26, 40, 60 and 70 inches diameter, the ratios of the volumes being 7.76, 16, 36 and 49, and the ratio of each cylinder to the one next to it 1 to 2 06, 1 to 2.25 and 1 to 1.36. Can you tell the reason why the fourth cylinder was made of such small diameter as compared to the others, or why the small ratio of 1.36 between third and fourth cylinders was adopted?

"Burglar," in your issue of February 22d, is very kind in giving us his methods of cracking so-called burglar-proof safes, and he shows clearly that in the contest between the burglar and the mechanic the burglar is now on top. The reason "Burglar" has succeeded so well is that he has not confined his professional education to the mechanical arts only, but has become something of a chemist and an expert in explosives. To defeat him the safe maker and owner must not rely only on the mechanic and the electrician, but must bring in the chemist. The students of Cornell University have recently gained some experience in gas chemistry and toxicology, which might be made use of. For instance, let there be various chambers behind the walls, above the ceiling, and under the floor of the outer safe vault, in which are secreted either cylinders full of compressed gas, or apparatus and chemicals which will begin to generate gas as soon as the doors of the outer vault are opened. The act of opening the door should operate a mechanical or electrical connection which would set the gas cylinders leaking, or start the apparatus working. The connection could be thrown out of gear by a clock mechanism before the proper hour for opening the bank in the morning. A lead chamber could also be placed in the ceiling, which would leak oil of vitrol if the vault were entered at the improper time, but the gases would probably be enough. Bisulphide of carbon and sulphuretted hydrogen would discourage a burglar by their smell. Chloroform, nitrous oxide, and carbonic oxide would put him to sleep, and chlorine and bromine would irritate him to a degree that might make him change his profession. Wm. Kent.



Oblong and Contracted vs. Round Cupolas.

Editor American Machinist:

P. C. Forrester, in the American Machinist of February 15, 1894, calls up the question, why contracted or oblong cupolas would not answer the purpose of bottom or side protruding "center-blast" tuyeres in round cupolas melting large amounts of pig-iron per day, to obviate the "cold center."

To answer tersely, I would say, contracted or oblong cupolas "bung up" more readily than round cupolas having as large an area at the tuyeres as above them. But to make the question clear in all its phases, it will be necessary to detail the action or process of "bunging up" as melting is continued in cupolas as used for foundry practice or a long run.

The action of a cold blast in entering a cupola chills the fuel at the side of and adjoining the tuyeres. The metal dropping down on this chilled fuel solidifies and forms a body of combined shot-iron and coke, and in cupolas contracted at the tuyeres or built oblong, the process of chilling has a tendency to continue until the whole area facing the bottom tuyeres is bridged or chilled over, and in which case, where there are no upper tuyeres, melting often would cease, and the less height existing between the bottom bed and lower or bottom tuyeres, the sooner would this occur, especially so if the fuel and iron are of a nature to create much slag and the same was not well run off at the tap or slag hole.

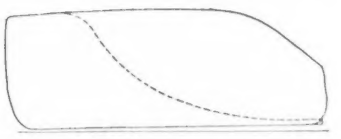
A plain round cupola about the same diameter at the tuyeres as above or below them would melt or run longer, all conditions being equal, than the oblong or contracted cupola. By contracted is meant cupolas that are built so as to be considerably smaller at the tuyere than elsewhere as shown in Fig. 2, as, for instance, we will take a cupola having a seven-foot shell with tuyere two feet from the bottom plate. Some years back cupolas were often lined after the plan seen in Fig. 2. Such a cupola would greatly obviate the "cold center," as far as getting the blast to the center was concerned, but its period for melting would be much shorter lived than with a cupola as seen in Fig. 1. These cupolas are supposed to be of about a seven-foot shell, and for such large size cupolas it is a good plan, instead of lining them strictly straight, to bring them in a little over the tuyeres about as seen at *B*, for while this throws the blast a little better to the center, it at the same time greatly prevents the dropping melted iron from running into the tuyeres. Some advocate, when lining a cupola, to give it a shape the same as would be assumed after being in use for a while, or about as shown at *K*. There are some points in favor of such a plan, but in my practice, I have large cupolas lined up as outlined on the side at *B*, and I think such insures the melting point existing longer ere repairs are required, and is a better plan than lining large cupolas as shown at *K*. The sketch, Fig. 1, shows the tuyere located in the lower part of the swell *B*. In most cases it would be best to have the swell *B* to start at the top of the tuyere instead of at the bottom, as here shown.

In melting large quantities of iron it is essential to have all the conditions possible to favor continued running without bunging up sufficient to bridge over or stop melting. We have but to look at the design or construction of cupolas used in Bessemer steel practice, to get a pointer on this question. Here we find cupolas will run a whole week, night and day, without "dropping their bottoms," and, if some foundrymen run a cupola of same dimensions for ten hours, they would think miracles had been achieved, and so there would be in cupolas of some designs. The secret of running steel work cupolas for a week at a stretch is in having high tuyeres and a good system of slagging out combined with a straight lining or a partial following of the design shown at *B*, Fig. 1, and if such have upper tuyeres of one or more rows they work much better where they only have one bottom row.

Some melters in running such cupolas do very little "poking at their tuyeres," and if their fronts should become clogged up, they generally let them burn themselves out, as the refuse blocking up the front of tuyeres is chiefly only clean fuel caked together with chilled droppings of iron, their tuyere being so high there is no chance for slag to reach up to them, which latter element is the greatest source for giving the melter trouble in foundry practice, on account of lower tuyeres. When we say some steel works cupola tuyeres are four feet above the bottom, the intelligent founder never having had an opportunity of seeing such work, will be in some position to comprehend why they are able to run so long without dropping bottom. Of course, most all founders now understand the lower the tuyeres are in a cupola for foundry practice, the greater the economy in fuel. Science in melting points out that the height above tuyeres regulates the amount of fuel to be used for a "bed." No matter how high tuyeres are, we must fill up above them with fuel from 20 to 30 inches for coke, and 14 to 20 for coal, the difference in height being chiefly regulated by the pressure of blast, and the weight of a heat. The greater the pressure or the larger the heat, the higher should be the bed up to the above limit.

I think from a study of this, it will be apparent to all why oblong or contracted cupolas are not encouraged or used in concerns having large quantities of iron to melt at one heat, and will permit Mr. Forrester to more fully conceive the purport in using the principles displayed in the bottom or side "center-blast" tuyeres recently illustrated by the writer in the pages of the American Machinist.

Thomas D. West.



Automatic Cut-off vs. Throttling Engines.

Editor American Machinist:

The question of the value of using steam expansively is raised at fairly regular intervals, and though it would seem that the subject had been through sufficient experiment and practice to have finally settled the matter definitely, it still comes up to trouble the engineer once in a few years.

If we take an engine under 25, possibly 50 horse power, under the conditions in which that size is usually run, there will be many cases that the throttling governor will be more economical than the automatic governor.

With that size boiler and the pressure usually carried the steam will be moist, and the automatic regulation will have no tendency to dry it, while with a throttling governor the steam will become dryer, and, in some cases, superheated, by the process of throttling, which of itself might result in greater economy than the expansion with wet steam.

Another important thing is tight valves. The small slide-valve-engine, where the valve has a constant travel, has a tendency to keep tight. An engine of this type that had been in use for many years and had come to that point that it was such a rattle-trap affair that it would hardly pay to put it in good shape, was replaced by a modern automatic engine with shaft governor, but the change resulted in bigger coal bills, and the owners wished they had the little engine that was broken up back in service again. The trouble in this case was not in the expansion principle, but because the valve of the new engine was of a type that it is very difficult to make, and keep tight, and it was simply a case of a leaky valve.

Another case was of an engine that gave a card like the full lines shown. It was very difficult to keep up steam, and it was thought that if an engine was put in of sufficient size to produce a card like the dotted lines, the boiler question would be all right.

The new engine was purchased and put in, but instead of easing up on the boiler it was impossible to keep the engine running over an hour or two without stopping to get up steam. This was another case of the old engine having a tight valve and the new one a leaky valve.

With small engines the slide valve can be kept tight, sometimes for years with a throttling governor, and this is one reason that they do so well. With small engines, even with the same type of valves, the throttling engine will usually come out ahead.

With large engines it is different, as the large valves necessary are difficult to make tight in the first place, and then there is so much surface and the liability of getting out of shape must always militate against their use except under low pressures. Lest some one should point to the locomotive, it should be remembered that locomotive cylinders are not very large.

The value of using steam expansively was demonstrated mathematically in the eighteenth century. It was brought to Mr. Corliss' attention by a mathematician. He then proceeded to the mechanical demonstration, and it was his good fortune to use a valve that would keep its shape and wear tight. Mr. Corliss accomplished three things: He used steam expansively, he reduced the clearance, and he made a tight valve. His valves and valve motion had the further merit of being easily operated, all of which good points have made it the leading engine.

Professor Thurston points out that Mr. Greene used a separate motion for his steam and exhaust valves. The Sickles cut-off was also operated by separate cam motion. Wm. Wright used two motions on his engines as formerly built by Woodruff & Beach and also by himself afterwards so long as he used the poppet valve. The Brown engine is another, but the use of two motions on the Corliss engines is of recent date.

Mention has been made that the Atlas Co. made Corliss engines some years ago with two motions but that the way they were made gave trouble. Does any one know as to truth of this? W. E. Crane.

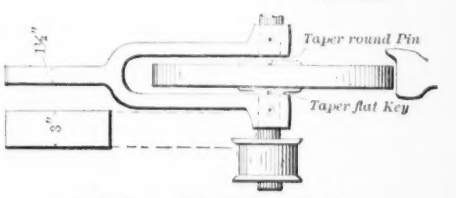
Circumference of Circles.

Editor American Machinist:

Mr. Wm. Cox is not justified in his assertion in your issue of the 8th, that $\frac{355}{113}$ is the "exact" ratio of the circumference to the diameter of a circle. He probably meant to say that it was correct for six decimal places, which is very near, but not "exact." The ratio is too large by the amount shown below:

3.14159292035398230088495575221 2 +
3.14159265358979323846264338327 95 +
0.00000026676360499162585219194 17 +

Expert.



EMERY WHEEL HOLDER
for Grinding Car Wheels

Grinding Car Wheels.

Editor American Machinist:

In regard to the question asked by "Reader," of Peekskill, Question No. 76, of February 15th, in your valuable paper, I would give a little of my experience in that line. It may be beneficial to him and others. Many years ago, when having charge of a railroad shop, I was much annoyed by having new car wheels flattened very often; sometimes the first trip they would come back with one or more spots of 1 inch to 2 inches diameter, and with wheels at from $9 to $12, each, this was an expensive business, so I thought I would try an experiment as a remedy. We had an ancient wheel lathe with wood frame, faced with cast-iron V strips on which the carriage traveled and tail-stock rested; we turned our driving tires with this lathe, though it was a slow business. I made an emery-wheel holder, something like the inclosed sketch, to fit into the tool post, holding an emery wheel 14 inches in diameter by 2 inches wide. With this rig we turned or ground off a good many pairs of wheels, grinding off some pairs three times before the chill was through. The passenger conductors were loud in their praise of the ground wheels, as they run so smooth and nice; afterwards we ground off some new wheels to put under our best coaches, and we were very much surprised to find how much *new wheels run out of true*, and consequently out of balance. The feed motion of this old lathe was a 6 inch wood shaft, the length of the lathe run overhead, with a 1½ square iron shaft run through it, with journals at each end, and a pulley on one end, with a

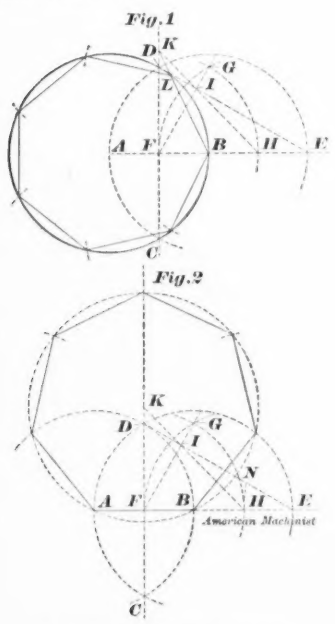
belt from the lathe spindle to drive it; a belt from the wood pulley to a pulley on the carriage, with shaft and pinion working in rack on the V piece that was bolted to the wooden frame of the lathe bed, fed the carriage back and forward; the way we changed the feed was to cross the down feed belt, or run it straight according to the way we wanted to feed the tool. Some of the boys might say, "I would not work such a lathe as that." It was not every man that could work it; it often seemed to have a will of its own, but, as a boss once told me, anybody can work with good tools, but it takes a good man to get out good work with such tools as those.

By the way, a man who became chief engineer of the U. S. Navy, I was told, run that old lathe in the early days of railroading, and another man, who has held the position as S. M. P. on the railroads of the Argentine Republic, turned many pairs of driving wheels on that same old lathe with me, when apprentice, but they often had to think about Job, and wonder if his patience would have held out when working with tools like that. The lathe was set taper so as to give the taper to the tire.

To get rid of the dust, I had a hopper under the emery wheel with a 4-inch stove pipe leading to a chimney, and a small jet of steam inserted into the end of the pipe where it entered the chimney, forming a blower, which carried off the dust, leaving the heavier particles of iron in the bottom of the hopper.

Jno. J. Bingley.

Watertown, N. Y.



The Regular Heptagon.

Editor American Machinist:

In your issue of February 1, 1894, you published an article, by Mr. S. H. Bunnell, describing a method by which an approximately regular heptagon may be inscribed in a given circle.

The method, which he says was discovered by Mr. A .L. Davison, and so far as the former knows, has never before been described in print, is, however, given in numerous text-books, and was probably first discovered by one of the ancient geometers while vainly attempting to solve the problem exactly.

Since the matter has come up, and it may be of interest to some of your readers, I hereby submit a method discovered by myself about eight years ago, which, though not quite so simple, reduces the theoretical error to about two-fifths of that of the other method.

In Fig. 1 A is the center and $A\ B$ the radius of the circle in which we wish to inscribe the regular heptagon.

Produce the radius $A\ B$ and about B as center and with $B\ A$ as radius, describe the arc $C\ A\ D\ E$, cutting the given circle in the points C and D, and $A\ B$ produced in the point E. Draw $C\ D$ and $D\ E$, and about F, the middle point of $A\ B$, as center, and with the same radius, describe the arc $H\ G$, and likewise about H the arc $F\ G$, these two arcs intersecting in the point G. Draw $F\ G$ intersecting $D\ E$ at I, and $H\ I\ K$ to meet $C\ D$, produced at K. Now draw $K\ B$ and that portion $L\ B$ of this, which falls within the given circle, will be one of the sides of the required heptagon, and this may then be completed in the usual manner.

The method may also be reversed, as shown in Fig. 2, in which the side $A\ B$ is given, on which to erect an approximately regular heptagon.

The mode of proceeding is readily seen to be the same as that described above, the point K here becoming the center of the circle in which the required heptagon will be inscribed, and this being drawn, the figure is completed in the usual manner.

For the mathematical investigation of the degree of accuracy of the methods, erect in Fig. 2 $H\ N$ perpendicular to $A\ E$, and suppose lines drawn from the points A and B to the point D, and also one from B to K.

The angle $D\ E\ F$ of the right-angled triangle $D\ E\ F$ being 30 degrees, the side $D\ F = \frac{1}{2}\ D\ E$, and likewise the side $D\ I = \frac{1}{2}\ D\ F$ in the triangle $D\ F\ I$, and hence $D\ I = \frac{1}{4}\ D\ E$.

Comparing the two triangles $D\ E\ F$ and $N\ E\ H$ we have, $D\ E : N\ E = D\ F : N\ H = F\ E : H\ E = 3 : 1$ (I), and hence $N\ E = \frac{1}{3}\ D\ E$, leaving $N\ D = \frac{2}{3}\ D\ E$ or $D\ E = \frac{3}{2}\ N\ D$, which substituted above gives $D\ I = \frac{1}{4}\ D\ E = \frac{1}{4} \times \frac{3}{2}\ N\ D = \frac{3}{8}\ N\ D$. This leaves $N\ I = \frac{5}{8}\ N\ D$, and hence as the triangles $K\ D\ I$ and $H\ N\ I$ are also similar, we get,

$K\ D : H\ N = D\ I : N\ I = \frac{3}{8}\ N\ D : \frac{5}{8}\ N\ D = 3 : 5$, which gives $K\ D = \frac{3}{5}\ H\ N$. But from proportion (I) we also get $N\ H = H\ N = \frac{1}{3}\ D\ F$, and substituting this value of $H\ N$, we find $K\ D = \frac{3}{5}\ H\ N = \frac{3}{5} \times \frac{1}{3}\ D\ F = \frac{1}{5}\ D\ F$. But $D\ F = \frac{\sqrt{3}}{2}\ A\ B$ as the altitude of the equilateral triangle $A\ B\ D$, and we finally get, $K\ F = K\ D + D\ F = \frac{1}{5}\ D\ F + D\ F = \frac{6}{5}\ D\ F = \frac{6}{5} \times \frac{\sqrt{3}}{2}\ A\ B = \frac{3\sqrt{3}}{5}\ A\ B$.

The trigonometrical tangent of the angle $F\ K\ B$ then becomes $\frac{F\ B}{K\ F} = \frac{\frac{1}{2}\ A\ B}{\frac{3\sqrt{3}}{5}\ A\ B} = \frac{5}{6\sqrt{3}}$, from which we find this angle to be 25° 41′ 36.2″, and twice this angle accordingly = 51° 23′ 12.4″.

For a perfectly regular heptagon this would be $\frac{360°}{7} = 51°\ 25'\ 42.8''$, and hence the error is 2′ 30.4″ as against 6′ 39″ by the method described by Mr. Bunnell.

It will be seen that the angle $K\ B\ A$ of Fig. 1 equals the angle $K\ B\ A$ of Fig. 2, and hence the identity of the two applications of the method.

Carl G. Barth.

Philadelphia, Pa.

Why Are the Castings Unsound?

Editor American Machinist:

Will you kindly reply through the columns of your paper and give me the information desired below. If you are not in a position to answer this yourself, probably some of your subscribers will be able to enlighten me on this matter. I am making some chilled shells for crusher rolls, varying from 20 to 24 inches outside diameter, with inside core ranging from 12 inches to 16 inches diameter, and from 12 inches to 24 inches face. The outside is chilled, and we use an iron that will chill about 1½ inches deep; the trouble with the castings is that they show scars and pit marks, as though they were afflicted with the small-pox on the chilled face. These marks or scars prove an objection with our customers, and it is to remedy this defect for which I wish the information. To anticipate any questions or further information that may be desired, I will state the various methods I have resorted to, but in no case with satisfactory results. I have gated these castings at the bottom and run them with four small gates there; have also gated at the bottom with a whirl gate; have likewise poured them from the top with different sized gates, varying in number from 2 to 25. Have also tried pouring them both hot and dull, and both fast and slow; have poured some in four or five seconds and have taken as much as a minute to pour others; have used the chills hot and cold and have cleaned the chills and used with them oil and plumbago, and even resin; have also used them perfectly clean and dry; have made the cope and drag with both green and dry sand, and, in fact, have used every means that I could think of to overcome this fault, but without success. These different methods have been tried both singly and together, but I feel satisfied that none of them can be relied upon. I will now leave the matter in the hands of your subscribers, some of whom will, no doubt, be able to throw some light on this matter, which will, no doubt, be of general interest to your readers.

Herbert M. Ramp,

Central Blast Cupolas—Suspiciously Large Melting.

Editor American Machinist:

I was much impressed with the article on "West's Center Blast Cupola," in your issue of November 2, 1893, knowing from experience that a center blast is just what is wanted in large cupolas and long heats for saving fuel and lining. But when I read the article on "Upper Tuyere Cupolas," December 14th, I was surprised. Melting 14,000 tons is equivalent to 50 tons per day for 280 days, and doing this without lining, seems a big thing to accomplish. I have seen a good deal of iron melted in different cupolas, but never saw or heard of anything like this, and think there may have been some mistake in the figures. If the figures are correct I would like to hear more of this, as the lining of a cupola is a rather important detail. Melting iron is a trade as well as molding, and much waste comes from neglect of lining, and in dropping the bottom, etc.

Melter.

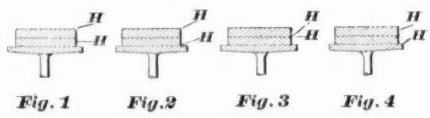


Fig. 1 *Fig. 2* *Fig. 3* *Fig. 4*

About Belts.

Editor American Machinist:

Users of machinery cannot fail to be interested in what Mr. F. W. Taylor says about belting, as published in the American Machinist of January 18th and 25th, especially since the data employed covers so many years, and has been taken with so much care and system.

There are a few points not touched upon by Mr. Taylor which, I think, are not settled by users of machinery. While it is the general practice to run leather belts with the hair side to the pulley, yet some think the flesh side adheres better, and so use their belts. This I believe to be true, but have no data to show the relative durability of the two methods, or the difference in driving power.

In the matter of double belts, there being four ways in which they can be made and applied, it becomes a question as to which is the best. Figs. 1, 2, 3 and 4 will show the different positions of the leather with relation to the pulley, the letter H refers to the hair side. A number of years ago my attention was attracted to this subject by an accidental experience with a double belt which had been improvised, in order to get more work out of an engine lathe. In the absence of a regular made belt I fastened two single belts together, by placing copper rivets at intervals of about 8″, the entire length. When the lathe was started the result was very satisfactory, but when stopped, great was my surprise in finding that every rivet had been pulled through one of the belts. Further investigation showed that an irresistible *creeping* had been going on slow, but sure. Subsequent experiments along this line showed that the amount of creep depended on how the leather was placed together, the greatest amount occurring where the position of the leather was as shown in Fig 4, and the least in that of Fig. 3. This seemed to be the result of a difference in the elasticity of the hair and flesh sides of the leather. In the case of Fig. 3 passing around the pulley, the two more rigid sides being in contact, the surface next the pulley was compressed as much as the outside was stretched beyond its normal condition. This action suggested another question which I had no means at hand of determining, viz., whether or not the gathering up of the more elastic surface next the pulley increases its adhesion.

These are questions of importance, I think, both to the makers and users of belts.

Another question analogous to this is, how much crown should a pulley have? There seems to be a wide difference of opinion on this subject between makers of pulleys, especially when comparing wood and iron pulleys.

Again, should a belt tightener, or idle pulley, be straight or crowning on the face? My practice has been to make them straight.

"Quirk."

The Lathe Leg Again—Factory Systems in Machine Shops.

Editor American Machinist:

The recent correspo dence on this subject is referred to by a California paper, with the comment that we are all of us wrong, and only just at the beginning of what was finally settled 20 years ago. There we are all in the wrong is that we have discussed the question quite irrespective of the nature of the floor, and this when of a solid unyielding nature demands the English form of lathe leg, but when a "floor," by which is evidently intended an upper floor as that of a gallery round a macnine shop, is used on which to stand a lathe, then the American leg is proper as a support.

The critic goes on, however, to say that nobody speaks out against the four legs and in favor of three, just as though we did not all know that three legs will take their own bearing and four will not. On this point, probably, a good many will be found to argue that the use of three supports for a long lathe are not as good as four. Some amount of care ought always to be given to the setting up of a tool exactly level, and the skill necessary to effect this is surely competent to secure that the four supports shall be well adjusted to their duty. Many others could be found who would argue that where three supports are used the third should be free of all absolute connection with the bed, which should simply be supported by the leg, but free horizontally.

I have been seeing something lately of the absolutely interchangeable system of machine manufacture. Where this system is carried out in its entirety so that there remains absolutely nothing to do but assemble the parts of a machine and set it to work, there is not much room for the handicraftsman. I mean that man who goes under the name of "fitter." In conversation to-day with one of the older fashioned all-round sort of men, of the stamp with whom my early days were spent, he referred to the complaint now so often heard that good workmen were very scarce, and he laid the blame for this entirely upon the employers who do not now take apprentices of the old fashioned sort, and see that they are taught their business properly. The result is that when they require one of these grown-up apprentices they cannot find one, and so they blame the workman and forget it is by their own culpable neglect that as the old men die out there are no new ones to take their places. The technical schools of to day are well enough in their way and have come to stay, but they cannot teach practice. They may teach a boy how to stand at the front of a lathe and turn out work to microscopical accuracy, but the bulk of work in this world is done by means and appliances often f removed from refined. The first work n me to do, when as an apprentice I sec the coveted distinction of being sent a breakdown job away from home, w to get down between two walls of masonry about two feet apart, between which revolved an engine fly-wheel of about 25 feet di eter covered with old black grease. The shaft had broken and we could not revolve the wheel, nor could we use a spanner on nuts, but we loosened these off with t chisel as best we could. I have never l so dirty before or since. Workmen who ow look on my present occupation as one of ease and

comfort would stand aghast or go home ill if it should fall to their lot to perform tasks that were set to us apprentices, and eagerly competed for by us. Nowadays there is very much the tendency to sit down and howl at matters that have not even begun to be difficulties, and this is, to my mind, very much a matter of early training, for I have observed that men who have had a harsh beginning make far fewer difficulties over work than do others. In the early days of English mechanical engineering the term millwright covered everything up to bridge building, and most of the big men of the past had begun life practically as tramps, with the difference that they worked their way along after making long stoppages where they happened upon more important pieces of work, and so they roamed about until some place offered sufficient inducement to cease roaming. The railways have spoiled all this, there is not much poetry in going by rail from one dirty town to another to find work in a shop which manufactures steam engines like cut nails, requiring no more setting up than is involved in two positions of a spirit level.

The old-fashioned engine was a work of art only half-finished when it left the works. It had four chief points of support and attachment to the building of a large beam engine with an entablature and columns, and when it reached a certain stage of completion we cut a wooden rod to send back to the shop to which to finish the piston rod, which was left for this purpose in order to allow for such want of exactness in the levels of the various foundation piles that might creep in. The first such work which I was given as apprentice lasted long enough to make me known to every one in the little country manufacturing town where we were at work. I nearly saw the inside of the jail, too, for we used to poach the salmon from the river Ettrick which ran by, and very good they were—far better than one gets here in London—and no one excepting a few narrow-minded, old Tory magistrates would have thought any worse of us for what we did, the game laws of this land being a disgrace, and quite opposed to public opinion. One man for whom I did some work was fishing one day with one of my friends and he exclaimed in course of conversation: "James, if it had na pleased Providence to pit me in sic a poseetion in life that I could hae a' the fushing and shooting I want, I wad ha spent hauf ma life in S—— gaol."

I look back on these early combinations of poaching and engine-fixing with pleasure. It was a sort of experience not to be had now, but I don't think we are better off in real truth for more modern methods of work, though, of course, no return is possible to the old fashions. Everything tends towards the factory system and to a class of machinery of every sort which can be most completely finished in the factory, leaving the minimum of field work which is always so much more expensive in the absence of the facilities of the factory.

Still, though conforming to the age, we may be permitted to indulge regrets for a past which made life more varied.

W. H. BOOTH.

To Prevent Rusting of Tools.

Editor American Machinist:

In addition to the reply you made to W. H. V., Answer No. 65, February 8th, let me suggest that after he has thoroughly cleaned and polished up the bright parts of his machine tools, that in the future he use a mixture of equal parts of lard oil and kerosene, and so far as the polished parts are concerned, he will have little trouble in keeping them bright. This mixture, however, will not answer for high speed machinery, but in practice has been found well adapted to engine lathes, milling machines and tools of a like character.

F. H. TREACY.

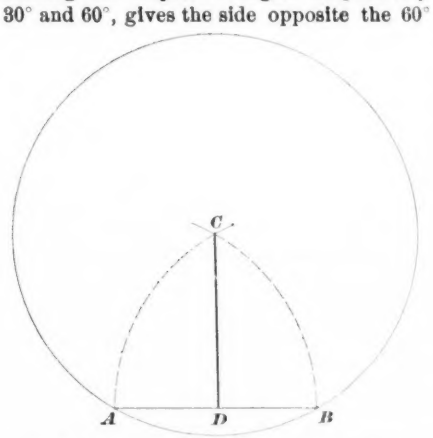
The Construction of a Heptagon.

Editor American Machinist:

The geometric construction given by Mr. S. H. Bunnell in your issue of February 1, 1894, is a very neat approximation for determining the length of the side of an inscribed heptagon, in order to lay off the same in any given circle. In fact, it is probably the only approximate one which has attained to any degree of use.

The same construction has been given in another form in Nystrom's Pocket-book of Mechanics for many successive editions. I saw it first in the third edition of 1856. It was probably in Nystrom's original pocket-book.

That Mr. Bunnell's construction is the geometrical equivalent of Nystrom's will appear by comparing the two. Mr. Bunnell constructs a right triangle, whose hypotenuse is the radius of the given circle; making the adjacent angles respectively 30° and 60°, gives the side opposite the 60°



THE CONSTRUCTION OF A HEPTAGON.

angle as the approximate length of the side of the inscribed heptagon. Nystrom's method consists in laying off the apothem *C D* of any side of the inscribed hexagon *A B* for the approximate side of the inscribed heptagon.

The above construction can be readily derived (or discovered, if you choose) by simply inspecting the following table. This shows the well-known relations between the apothem (or radius of the inscribed circle) of any polygon, and the length of the side of the given polygon.

Name of Polygon.	No. of Sides.	Radius of Circumscribed Circle.	Apothem, or Radius of Inscribed circle.	Side of Inscribed Polygon.
Equilateral Triangle...	3	1.0	0.50000	1.73206
Square.....	4	1.0	0.70711	1.41421
Pentagon..	5	1.0	0.80903	1.17558
Hexagon..	6	1.0	0.86603	1.00000
Heptagon..	7	1.0	0.90101	0.86778
Octagon...	8	1.0	0.92387	0.76536

These proportionate relations hold for any circle, but are usually, as given, for a circle whose radius is unity, as one inch. The apothem increases while the side of the succeeding polygon decreases, the two becoming nearly equal for the heptagon. In other words, the apothem of the pentagon is less than, the apothem of the hexagon almost equal to, while that of the heptagon is greater than the side of the inscribed heptagon. The most natural solution of the problem, therefore, is to devise a simple construction for the apothem of the regular hexagon inscribed in the given circle. The two forms of this construction have been noted above.

There is no process of proving an approximate geometric construction; that only can be mathematically proven which admits of proof. We may show the probable error of an approximation, and know within what limits we work when using it. The constructed heptagon side is 0.86603 inches, in a circle whose radius is one inch. It ought to be 0.86778 inches. Therefore, the error is 0.00175 inches in 0.86778 inches, or the approximate side of the heptagon is almost exactly 0.2 of one per cent. *shorter* than it should be to go just seven times around the circle. The error can be seen in a large circle. In one of 100 inches radius, the constructed side is 0.2 inch shorter than the true length.

Aside from the exact construction given in geometry, there is probably to-day no better nor more readily applied rule than Nystrom's, the apothem of the inscribed hexagon is (nearly) equal to the side of the inscribed heptagon.

WM. S. ALDRICH.

Morgantown, W. Va.

Neutral Axes of Beams.

Editor American Machinist:

Permit me to say in reference to the discussion on location of the neutral axes of beams, that the difference of opinion expressed in your paper is most likely due to a slight misunderstanding on the part of some of your correspondents, as to the action of a solid under extension and compression within its limits of elasticity. The ultimate strength of the material used has nothing to do with the question.

If the increase in length, under a given stress, of the fibers in a beam that are in tension, differ from the decrease in length of the fibers that are in compression, and under the same stress, the neutral axis cannot pass through the center of gravity of section. Since, however, a perfectly elastic body increases or decreases in length the same amount, for a given stress, whether under tension or compression, and the elastic limit of any material is that point up to which it acts, *very nearly*, as a perfectly elastic body, the neutral axis of a beam must pass *very nearly* through its center of gravity.

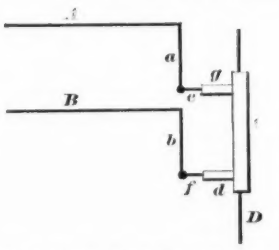
I have met a great many who have been unable to understand the accepted theories of beam flexure, and have always found that they believed the extensions and compressions of a body, under a given stress, were in the same ratio as the ultimate breaking strengths.

That a material will stand a greater load under one stress than under another, simply means that it will stand, as in the case of cast iron, being compressed for a longer time than it will being pulled apart. The actual extensions or compressions, per unit of load, will be the same in either case.

The elastic limits may be different, but for the same body, the rates of elasticity must be the same whether under tension or compression.

The words, *very nearly*, above, are used because, even within the elastic limit, no material body is *perfectly elastic*, small permanent sets being caused by even the slightest stresses. These, however, are so slight that it is best to treat the subject as pertaining to bodies having perfect elasticity. As a matter of fact, the subject is so understood and treated by engineers throughout the world.

GEO. N. VANDERHEAD.



Not New, but Patented.

Editor American Machinist:

In your issue of February 15th I noticed with special interest an illustration of a mechanical motion, being one of the many very interesting solutions of the problems given by Leicester Allen. The illustration in question is the one marked Fig. 4, page 3. Having called Mr. Allen's attention to this motion, as illustrated in the right angle coupling which I have been manufacturing for the last 13 years, I am somewhat surprised that he should have forgotten to mention my device when commending Mr. Alfred Johnson for his contribution of Fig. 4.

I inclose a copy of patent drawing dated January 9, 1881, in which Fig. 4 is plainly shown, together with several other possible modifications of this invention. It seems to me that Mr. Johnson, after the encouragement given by Mr. Allen's remarks, might be inclined to go to some expense, in the way of models, patents, etc., feeling assured that the device must be new, if it would pass the scrutiny of a man of Mr. Allen's qualifications. Undoubtedly, very many of the solutions of Mr. Allen's problems are entirely new, and many of them are new to the contributors, but if an engineer so well acquainted with mechanical motions as Mr. Allen can make such an oversight as the one to which I call your attention, is it not worth while to make mention of this, thereby, perhaps, preventing some one of your many readers from incurring expenses which might otherwise be avoided?

T. R. ALMOND.

Milling Machine Work.

Editor American Machinist:

I have been quite interested in reading the articles on milling and milling machines, but beg to preface this letter by saying it is quite possible I have not read everything that has been published in the AMERICAN MACHINIST on this subject, and not till to-day did I intend to say one little word for or against the problem of milling in general or specific.

I must say I am in entire sympathy with Mr. Crank (I do wish he would give us his correct name, for I dislike to call any one a crank—unless he is one—but he forces me to do so, although I will be as polite as possible, and prefix Mr. to his name) in the matter of being correctly quoted, I have had that played on me several times, and it is not pleasant nor just, and a correspondent who does that ought to have his letters returned to him.

Quoting from Mr. Crank's letter, he says: "The fact is that even the best universal milling machines of the present day are not adapted to removing large quantities of metal rapidly and accurately, their chief value being that many kinds of work can be done upon them that cannot be done on other machine tools without the assistance of much hand skill. You could not expect much execution from a machine built as they are."

From the above quotation and from what immediately follows in Mr. Crank's letter about a certain kind of a milling machine, it is possible this milling discussion began with reference to some particular kind of machine, and it is for that reason I preface my letter; if this is the case I am "not in it," but if such is not the case Mr. Crank is "not in it," and I am.

When the subject of milling is mentioned, most people picture in their mind's eye what is known as the universal milling machine for doing the work; but I take it that much of the work required to be done, and which has been in the minds of your several correspondents, has been of a character quite impossible to be done on such a universal machine as one finds in the catalogues of different tool makers, and to such a one, the description given by Mr. C., above referred to, seems very contracted, and not at all covering the ground of milling in its broadest application, and if he ever gets a milling machine on his hands that he doesn't know just what to do with, just transform it into a facing-off lathe for small work, and set a boy to run it, and it will pay a good interest. I was there once, and it was the most satisfactory tool I had in the place for the class of work I kept it on.

Now a word about milling in the broad application. There is lots of heavy work done to day that, in my estimation, can be done cheaper, quicker and more accurately on a milling tool than by the methods in use, but it needs special fixtures of many kinds, and, of course, a class of work that is made in quantities, and, in some cases, the parts patterned with reference to such milling. I have in my mind's eye not a complicated circular cutter with a great variety of forms, but a good strong head with independent cutters and a stiff strong spindle, possibly running vertically at that, and a system of vertical and cross feeds that will cut off the metal like old cheese or with the fineness and accuracy of a grinding machine, and it is being done to-day.

O'ROSCO C. WOOLSON.

In Jersey City during the recent snow storm, the horse railways most distinctly got away with the electric railways. The electric cars were in dead blocks, while the horse-car drivers jumped the blocks, ran around them on the pavements and went their ways.

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Railroad Employes and the Courts.

Most of those who have given attention to the matter agree that present indications point to a state of affairs in which both railroad officials and railroad employes will be considered as being primarily servants of the public; servants engaged in doing a work which is a vital necessity, and must not, on any account, be suspended, while questions of wages or other matters of dispute are being settled.

As our readers well know, we believe it is important that railroad men and all other workmen should receive, at least, fair living wages—important not only to those who receive these wages, but to others and to society; but it is also important—and becoming daily more so—that railroad trains should run uninterruptedly; and it seems as though things ought to be arranged so that they could do this pending the settlement of disputes.

Recently a court has enjoined the employes of a railroad from in any way acting in concert for the purpose of interrupting the traffic of the road; said road, being, at the time, in the hands of a receiver. On the other hand, the receivers of the Union Pacific road were ordered by a court to rescind an order reducing wages practically without notice, and substitute therefor a notice, or a proposition, for a re adjustment of wages with 60 days' notice for the purpose of conference with representatives of the men.

It seems to us that these cases, with others that could be cited, mean nothing more nor less than that the community is going to have, in the future, much more to say regarding these matters. It will be more fully understood that every one connected with a railroad has a public duty to perform.

With this added responsibility there should undoubtedly be added security for employes; for, if the privileges freely conceded to all others are to be abridged in their case—if they are not to be allowed to cease work at a time or under circumstances chosen by themselves, then they must be, by the same power, protected from arbitrary discharge without good reason, and especially without notice. In short, the same principles must be applied to this that are applied to other matters in which men make contracts, assuming mutual obligations and responsibilities. It is to be regretted, of course, that the reign of reason, and the spirit of mutual respect and consideration are not sufficiently manifested in railroad circles to make it entirely unnecessary for the State to interfere for its own protection; but as matters now stand, we cannot see but that appeal to the courts will, in the end, be best for all concerned.

A great deal is said anent the failure of the unemployed to take hold of opportunities to work outside their regular vocations. That is, when men are offered work at something with which they have no acquaintance, they do not, as the expression goes, "catch on." It would, perhaps, be a good thing if the carpenter took kindly, in times of emergency, to shoveling gravel—good for the carpenter, but how about the fellow who gets his living by shoveling gravel? The economical plan of the age is that men shall be specialists. This is probably best, but when men are expected to change from one thing to another it has its disadvantages. Nowadays the man who feeds the work to the machine is not supposed to know anything about its coming out. When it is expected that he shall go to the other end of the machine he hesitates because he does not know anything about the other end. Against the disadvantages of devoting the man to one end of the machine must be put the advantages of his being able to produce the most under ordinary conditions of trade. But it is, all the same, bad for the man in times of business depression—scrambling for work. There is no doubt but the individual workman gets rather the worst of it, in this sub-division plan, in times of depression, but perhaps he gets enough the best of it in good times to even it up, so far as such things can be evened up. When times are good he can live anyway; what he is mainly interested in is how to live when times are bad.

We have seen at various times and in various journals (electrical and otherwise) statements regarding the comparative earnings per mile of electric and horse cars on the same system, *i. e.*, the West-end system of Boston. A recent statement of this kind shows that while the mileage of the electric cars of this system was 76.17 per cent. of the entire mileage of all the cars of the system, their earnings were 80.33 per cent. of the whole, from which it is deduced that electric cars earn more money per mile run; which, it seems to us, is an entirely unjustified deduction, so far as comparisons between electric and horse cars generally are concerned.

If a street-car company owning two lines, one traversing a thickly built up portion of a city, where crowds of people desired to use cars, the other being in the outskirts where few people used the cars; and if the first mentioned line used horses, while the suburban line was electrical, comparison of earnings per mile would show the horse cars to possess much the greater earning capacity. But such a comparison would be unfair to electrically driven cars.

By this criticism we do not mean at all that we prefer horse cars, but that comparisons should always be fairly made.

We think that if there were in the same street of a city two parallel lines, one with electrical, the other with horse cars, the electrical cars would show the best earnings per mile, because people would prefer them, on account of their greater speed, cleanliness, etc., and such a comparison, if it were possible to make one, would probably show greater superiority of electric over horse cars than is shown by the comparison quoted above.

Safe Breaking.

Mr. William Kent, on another page, suggests the possibility of frustrating burglars by chemical means. As he points out, the burglar is a chemist as well as a mechanic, but in the same sense every first-class mechanic is a chemist, for the skilled burglar is a first-class mechanic, and nothing else. Chemistry plays a secondary part. The farmer knows how to blow up stumps by the use of high explosives, if that is chemistry, and every man of ordinary intelligence understands how to dilute and dissolve high explosives in a way to introduce them into minute crevices. As to noxious gases that will disturb the burglar, the plan of neutralizing them is always either well known or readily found out by the expert, and this we do not think would trouble him seriously when he knew what he had to contend with.

As the matter of safes stands just now, or is likely to stand in present knowledge, we believe that the question of opening a safe is only one of time, and that the one requiring the longest time to enter is, all things considered, the best. No first-class mechanic would ever doubt his ability to work his way into a safe, despite of all that chemistry could do to prevent.

Chimneys.

We publish elsewhere in this issue a communication from William Barnet Le Van, relating to chimneys. Without indorsing all he says, some experience in the line of his discussion constrains us to admit that there is a good deal of truth in his statements. The theory of chimney draught is plain enough, but it is not comprehensive enough to cover the cases constantly coming up in practice. There are few men of experience in the erecting of steam engines and boilers that have not at some time made connection to a chimney, in the doing of which all theory pointed to a failure, but which in practice was successful. And the exact contrary of this has often occurred. These are simply some of the things that a man will do in meeting conditions as he finds them, taking, as must be admitted, chances which in every-day practice must be taken, notwithstanding all that is said to the contrary.

Possibly, if all conditions below the chimney were submitted to rigid analysis, every discrepancy could be explained, and, then again, possibly, it might be found that there was a missing link. There are very few things about which *all* is known.

The principal paper in *The Stevens Indicator* for January, is a graduation thesis by three students on "Test of the New York Hygeia Ice-making Plant," which is located at the foot of East Fifty-second street, New York City. An abstract of this test was published in our issue of January 11, 1894. There are other papers of interest in the *Indicator*, the one referred to being mentioned from its leading character.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(110) R. W., Cleveland, O., asks: 1. Is it necessary to have a good water supply to use a condenser with a steam engine? *A.*—Yes. 2. Is not air used to condense steam? *A.*—Not to any extent in the instance of a steam engine.

(111) Alpha, Schenectady, N. Y., asks: How is leatheroid made? *A.*—Leatheroid is a material made by treating vegetable fiber with certain chemicals, and having qualities resembling leather. We have had no experience in this line of work, and cannot give you the exact process. Your other question is out of our line.

(112) C. J., New York, writes: I am about to build an engine for a boat 30 feet long; please state about what size of an engine will I require; also give dimensions of boiler. *A.*—Diameter of cylinder, 4 inches; length of stroke, 5 inches. Vertical tubular boiler, inside diameter of furnace, 31 inches; height of furnace, 26 inches; thirty-seven 2 inch tubes, 29 inches long. Diameter outside of shell, 37½ inches; total height of shell, 55 inches.

(113) D. W. F., Altoona, Pa., writes: The diameters of the steps of a cone pulley for a small lathe are 6, 4 and 2 inches. What size gears should be used to make a back-geared lathe out of it, and to decrease the speed in proportion to the steps of the cone? *A.*—On the small end of cone use a pinion 1¼ inches pitch diameter, meshing with a gear 8 inches diameter, diametral pitch, 14. On the large end of cone use a wheel 7¾ inches pitch diameter, meshing with a pinion 1¼ inches diameter, diametral pitch 12.

(114) W. E. S., Westminster, Md., writes: We have rolled a set of flues, and tested them with a steam pressure of 60 pounds, and they did not leak, but when the pressure fell to 20 pounds we detected leaks. The flues seem to be in good order. Please give the cause for the leaks at low pressure; we have given it up. *A.*—The cause is probably due to the construction of the boiler, which permitted some of the parts to expand or contract, so as to make the boiler tight at the high pressure, and leaky at the low pressure.

(115) A. W. P., New York, writes: I want to find the pitch of a pair of spur wheels. One is 4 inches diameter, and the other is 8 inches diameter. I want 15 teeth in the pinion, and I compute its pitch to be .785. But I cannot get the pitch of the other wheel without a remainder. I must have 6 inches between centers, but I can change the diameters of the wheels a little. Please advise me what to do, through your columns? *A.*—The only cause for your worry is that you have made a mistake in the computation of the pitch of the pinion; the circumference of a circle 4 inches diameter is 12.5664, dividing this by the number of teeth (15) we have for the pitch 0 837+ inch. The diameter of the wheel being double that of the pinion will require 30 teeth; and its circumference divided by 30 will give precisely the same pitch as that of the pinion.

(116) T. H. M., Brooklyn, N. Y., writes: A says that, if there be a pressure of 100

pounds per square inch at the bottom of a column of water contained in a pipe of, say, 2 inches diameter, the pressure will be increased, if a tank be placed at the top; and, that it will be increased as the area of the bottom of the tank is increased, the height of the water to remain the same. B says the pressure per square inch will remain the same in both cases, no matter how great the area of the tank. Which is correct? *A.*—B is right, as could easily be found by reference to any elementary treatise upon hydraulics. It is a fundamental principle of hydraulics that static pressure per unit of area is dependent solely upon vertical distance from the surface of the water to the point at which the pressure is considered; and this is true regardless of the form of the vessel in which the water is contained. A moment's reflection will show that if A's contention were true, steam gauges would have to be graduated with reference to the size of boiler they are to be used upon; or, that, in a system of water-works, the static pressure at any given point would depend, not upon the difference in level between that point and the surface of the water in the stand-pipe or reservoir, but upon the size of stand-pipe or reservoir, which is equally absurd.

(117) J. H. T., Chicago, Ill., writes: I would be very much obliged if you would explain to me this statement if it is true. "When melted cast iron is poured into a mold it expands in solidifying and presses into every part of the mold." This hardly seems true to a patternmaker unless it shrinks up immediately to agree with his rules, but because I do not understand this I do not say it is in any way incorrect. *A* — If this is true, and we are inclined to believe that it is, it is one of the mysteries of nature into which we cannot penetrate, but the explanation which you quote need not confuse you. For example, if you take water at any reasonably high temperature—say 200 degrees—in cooling it will contract until within a few degrees of the freezing point, then it will expand until it solidifies, bursting, as you know, a vessel of great strength We assume that cast iron follows this law, expanding *at and about the time of solidification* so as to fill the mold and afterwards contracting as the heat becomes less, so that when it becomes what we call cold, it measures less than the pattern. This would be the case with ice if it were reduced in temperature. Just when the melted iron ceases to contract and begins to expand is not known, so far as we are aware.

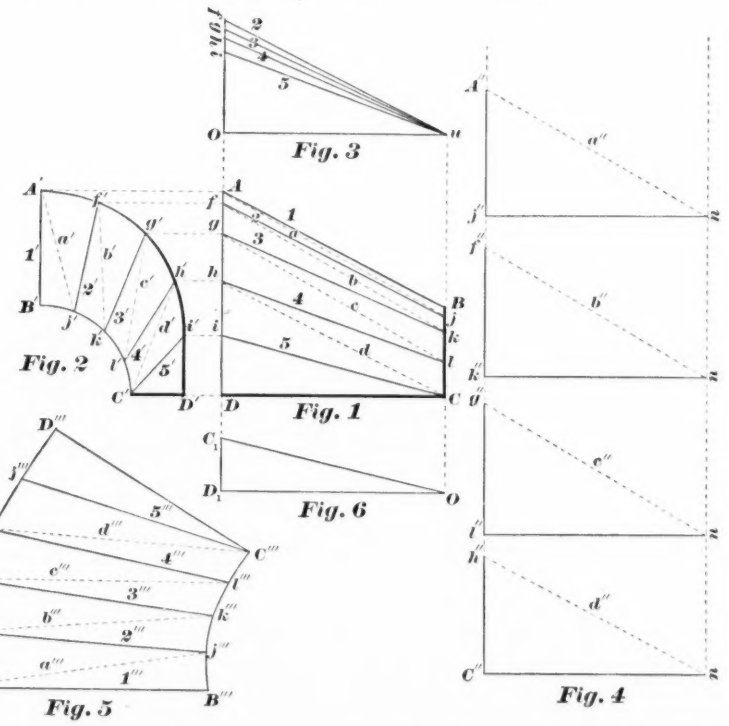
(118) A. M., Charleston, S. C., writes: Please inform me how to set a variable cut-off valve of the kind generally used on tugboat engines? *A* —We suppose you refer to the Meyer valve. Before any attention can be paid to the cut-off valve, the main valve must be correctly set. We shall assume that this has been done. Set the cut-off eccentric directly opposite the crank, place the cut-off valves in the center of their respective threads, as near as can be done by ordinary measurements, great accuracy is not necessary, and make complete connections between eccentric and cut-off valves. Now set the crank in a position at which, under ordinary conditions, the steam is to be cut off, then set the corresponding cut off valve to cut off at this point, this is accomplished by turning the valve stem so as to spread the valves or draw them together as the case may require. Now set the crank in position for the return stroke to cut off at the same part of the stroke. If now the corresponding valve is not in a position to cut off, then lengthen or shorten the distance between the valves and eccentric by one-half the difference that this valve is out of its correct position. Lastly, turn the valve stem so as to set the valves for the correct point of cut-off. Verify the result by turning the crank-shaft two or three revolutions; a little readjustment may be necessary. The above is for valves whose outer edges close the ports. When the inner edges close the ports, the eccentric must be set in direct line with the crank.

(119) W. T., Wilmington, Del., writes: I wish to make a set of drawings for a quadruple-expansion engine to develop 300 indicated horse-power at 150 pounds boiler pressure. The dimensions for the cylinders that I have decided upon are high pressure cylinder 9 inches diameter; first intermediate pressure cylinder, 13½ inches diameter; second intermediate pressure cylinder, 22 inches diameter, and the low-pressure cylinder, 33 inches diameter. Stroke, 16 inches; number of revolutions per minute, 225. Kindly inform me through your columns if the above dimensions are correct. Also give me an approximate rule for determining the diameters of cylinders for this class of engines when that of the high-pressure cylinder is given. *A.*—We do not see the necessity of using a quadruple-expansion engine for so low a boiler pressure, a triple-expansion should do the work economically. But should you insist upon adopting a quadruple engine, the diameters of the cylinder given by you are, in our opinion, not well chosen. We should make the H. P. cylinder 11 inches diameter, first I. P. cylinder 14¾ inches, second I. P. cylinder 21 inches, and L. P. cylinder 31 inches diameter. The rule for finding the areas of the different cylinders is as follows:

Area of H. P. cylinder × 1.8
= area of first I. P. cyl.
Area of H. P. cylinder × 3.6
= area of second I. P. cyl.
Area of H. P. cylinder × 7.9
= area of L. P. cylinder.

2. Is there a book published treating on compound, triple and quadruple-expansion engines? *A.*—"Manual of Marine Engineering," by A. E. Seaton, treats on the above class of engines; it is a good book.

(120) A. S., Muncie, Ind., writes: Please give me the correct formula for making both blue and black prints. *A.*—This is an ever-recurring request, but since the process is an important and useful one, we give the following reprint of an answer describing the process and a simple outfit required, which any one can easily make for himself for home or office use. Procure an ordinary picture frame and glass; into the frame fit a back or wooden board about ½ of an inch thick. cover one side of this board with three thicknesses of flannel, and on the rear of the frame screw loosely four buttons, so that the back or wooden board can be kept in the frame. Dissolve 2 ounces of citrate of iron and ammonia in 8½ ounces of water; also dissolve 1½ ounces of red prussiate of potash in 8½ ounces of water; when the two are dissolved mix them in a dark bottle and keep it in a dark place for future use. Procure sheets of paper somewhat smaller than the inside of the frame. The paper should have a hard surface, so that the liquid can-



not easily soak into it. Coat this paper with the solution previously prepared; to do this use a sponge dipped into the solution and then draw the sponge lengthwise and crosswise on the paper so that the paper will receive an even coating, and hang it in a dark room or closet to dry; when dry keep the paper in a dark place. When a blue print is to be taken, place the tracing in the frame with its face on the glass, on the tracing place the paper with its coated face on the tracing; on this paper place the board with the flannel in contact with the paper and fasten the board into position by means of the buttons attached to the frame. Expose the tracing to a strong sunlight for about 3½ to 4 minutes, then take the paper out of the frame and place it in a tub of water and let it remain there for about 5 minutes; after this take it out and let it dry, and thereby finishing the blue print. The black print processes which have any practical value are, as far as we know, patented. The nigrosine process we believe to be a good one, it gives permanent black lines on permanent white ground. The process is nearly as simple as the blue process, the chief difference being that it requires a chemical developer added to the water bath. The paper must be carefully protected from the light, as it is more sensitive than the blue process paper, and it must be kept absolutely dry. Full directions for printing and developing are supplied with each roll of paper, which can be obtained from Keuffel & Esser Co., New York.

(121) F. J. M., Altoona, Pa., writes: Please give me a method for developing a tapered course for a locomotive boiler. Its side view is shown in Fig 1, and half an end view in Fig. 2. *A.*—Divide the curved part A' i' in Fig. 2 into any number of equal parts, say four, and thus obtain the points f' g' h'. Also divide the curve B' C' (Fig. 2) into the same number of equal parts, and thus obtain the points j' k' l'. Join the points f' j', g' k', h' l', and i' C'. Square the points f' g' h' and i' over to A D in Fig. 1, and thus obtain the points f g h i Also square the points j' k' l' over to B C (Fig. 1), and thus obtain the points j k l. Join f j, g k, h l; these lines represent lines drawn on the surface of the tapered course, but we do not see their correct lengths, and since the correct lengths are required for the development, we proceed to find them as follows: Draw any line o u, Fig 3, and make its length equal to D C (Fig. 1). Through o draw a line perpendicular to o u; on this line lay off o i equal to C i' in Fig. 2; join the points i u, then this line 5 will be the correct length of the line 5 in Fig. 1. Again, lay off o h in Fig. 3 equal to l' h' in Fig. 2; join h and u, then will h u, or line 4, be the true length of line h l or 4 in Fig. 1. In a similar way the true lengths of the lines 3 and 2 are found, and since the same letters designate the same points in the different views, there should be no difficulty in tracing the different distances laid off in the various views. For the development, we also need the auxiliary lines a b c d indicated by the dotted lines Of these we must also find the true lengths; the method for doing so is similar to the one adopted for finding the lengths of the lines 2, 3, 4, 5, and we would obtain a figure similar to Fig. 3; but since this will bring the development of the lines too close to each other, we have shown, for the sake of clearness, the development of each line separately in Fig. 4. Make C' u (Fig. 4) equal to D C in Fig. 1; through C'' draw a perpendicular C'' h'', and make its length equal to C h' in Fig. 2; draw a straight line h'' u, this line and the line $3'''$ drawn from g''' to k''' is the proper location in the development of line 3, in Fig. 1. In a similar way we locate the lines $4'''$ and $5'''$ in the development, and draw the curves through their extremities. The surface bounded by these curves (B''' C''' and A''' i''') and the straight lines A''' B''' and i''' C''' is the development of one-half of the curved surface in Fig. 1; to this must be added the straight surface C D i. To do so we must find the correct length of C D in Fig. 1. Make D_1 O, in Fig. 6, equal to D C, in Fig. 1, and the perpendicular C_1 D_1, in Fig. 6, equal to C' D' in Fig 2. Join C_1 and O by a straight line, which will be the true length of C D in Fig. 1. From i''' in Fig. 5 as a center, and with a radius equal to D' i' in Fig. 2, draw a short arc passing through D'''; and from C''' as a center and with a radius equal to C_1 O in Fig. 6, draw a short arc passing through D'''; from this point of intersection draw a straight line to C''', also draw a straight line from i''' to D'''; this completes the development of one half the surface shown in Fig. 1. This construction may seem to be complicated, but it is really a very simple one. It will be seen that it consists simply of finding the true lengths of lines assumed to be drawn on the curved surface, and the true length of the auxiliary lines, then locating these lines correctly in the development, and finally drawing the curves through their extremities, all of which does not require an extensive knowledge of geometry.

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New Form of Prony Brake.*

BY R. C. CARPENTER, ITHACA, N. Y.

The form of brake described in the following paper was designed by the writer about two years ago, and three brakes, each of about sixty horse-power capacity, have been in use on the experimental engine of the Sibley College laboratories for a considerable portion of that time.

The brake consists, in each case, of a tube of copper, with an elliptical section, which nearly encircles the brake wheel.

* Presented at the New York Meeting, December, 1893, of the American Society of Mechanical Engineers.

Outside the copper tube is an adjustable band or belt of sheet steel, which prevents the copper tube from expanding. Water pressure is applied to the copper tube by means of hose connections made near the center of the wheel to water pipes; the amount of pressure being regulated by throttling the admission and discharge valves. As the external diameter of the copper tube cannot change, the internal pressure causes the inner surface to rub against the wheel, producing the friction which is used to absorb the work. To prevent the wearing of the inner surface of the copper tube a thin sheet of steel or Russia iron is inserted between the tube and the brake wheel, and connected to the brake so as not to revolve.

This brake has proved very satisfactory; the work is readily absorbed by varying the opening of the supply and discharge valves, and no trouble has been experienced on long runs from heat or irregular friction of the brake.

In the figures which follow, the principal parts and dimensions are as follows:

Fig. 1.—Elevation of wheel with attached brake. Wheel, 4 feet diameter, 12-inch face; *A*, supply pipe; *B*, discharge pipe; *C*, brake; *D*, sheet-iron liner; *F*, external strap sheet-iron; *G*, adjusting bolts in external strap; *H*, arms of brake riveted to external strap; *J*, support for brake arms, to be carried on platform of weighing scale.

Fig. 2.—Section of brake and rim of wheel. *C*, brake, elliptical section; larger diameter, 12 inches; shorter diameter, ⅝ inch; *F*, external strap; *D*, sheet-iron liner.

Another merit, which in some cases may be of little moment, but which was of considerable importance at the time of its erection, was the fact that the first cost was small, the brakes not costing over fifty dollars each.

AUTOMATIC REGULATING DEVICE.

Prof. C. W. Scribner designed a self-regulating device which I consider of great merit, but which, because of pressure of other work, has not yet been applied to the brakes just described. There is, however, no doubt of the effectiveness of the design, and its description is therefore here given.

So far as the writer knows, every previous device for automatic regulation of the work absorbed by a brake requires the rotation of the wheel to be such as to tend to move the free end of the brake arm in an upward direction. This is oftentimes objectionable, and sometimes an element of danger. In this case Professor Scribner permits a downward motion of the brake arm, and yet succeeds in securing motion sufficient to adjust the tension on the brake.

The general method of securing the adjustment is shown in the diagramatic form, Fig. 3, in which *A C* and *B C* are the brake arms, these rest on the end of a horizontal lever *K C*. This lever is supported at *D* by a knife edge on the fixed support *D E*. A movable weight *F* is placed on the arm of the lever at any point needed to give the required brake load. If the brake load is too great, the pressure at *C* is greater than at *F*, and the point *K* of the lever rises; on the other hand, if the brake load is too small, the pressure at *F* is greater than at *C*, and the end *K* of the brake arm falls.

The motion of this point can readily be utilized to decrease or increase the tension on the brake as required. In this case this motion will be utilized to regulate the opening of the supply valves, and to vary the pressure on the brake. The weight *F* can also be utilized to weigh the load. The detailed drawings for this purpose are shown in Fig. 4.

The principal parts are as follows:

A, supply pipe; *B*, discharge pipe; *C*, brake; *F*, external sheet-steel strap; *G*, adjusting bolts in external strap; *H*, arms of brake fastened to external strap; *M*, weighing lever; *W*, weight; *O*, knife edge between lever and stationary support; *N*, knife edge between brake arm and lever; *P*, hand-wheel to adjust load on brake.

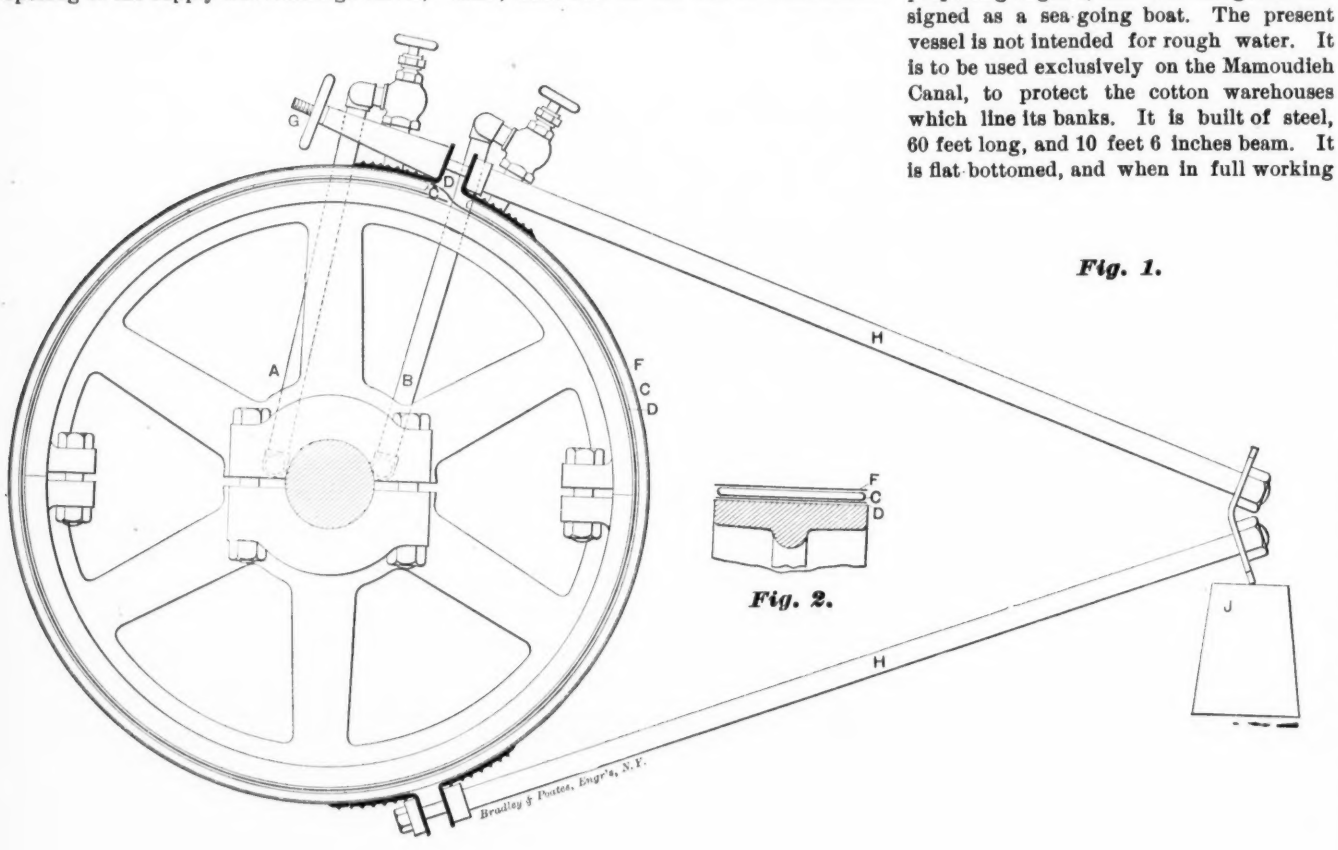


Fig. 1.

Fig. 2.

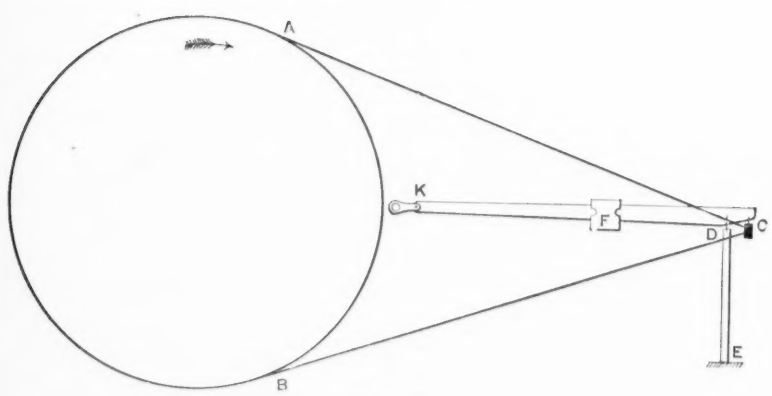
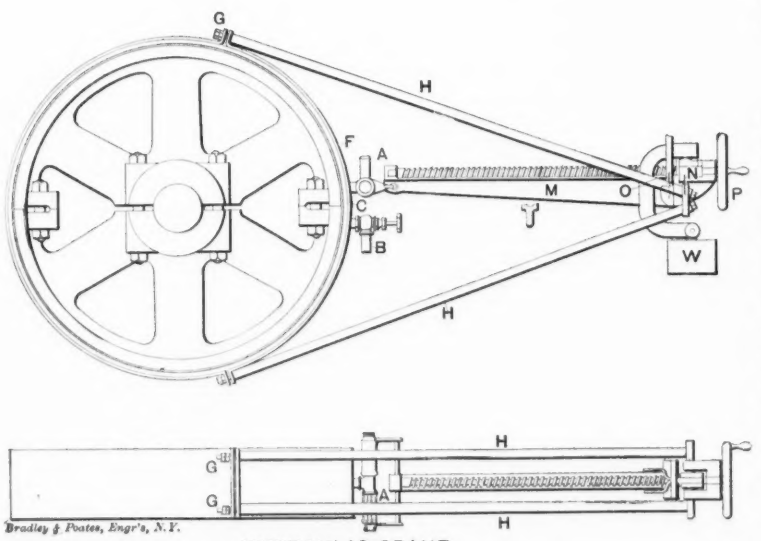


Fig. 3.



HYDRAULIC BRAKE

Fig. 4.

Hydraulic Propulsion.

On the afternoon of the 23d inst. a number of engineers and naval men met at Messrs. Merryweather & Sons' Works in Greenwich Road to witness the trials of a new floating steam fire engine, with hydraulic propulsion, for the vessel which that firm has just completed for the Chamber of Commerce of Alexandria.

Some eight years ago Messrs. Merryweather supplied the Egyptian Government with a floating steam fire engine for the harbor of Alexandria, where it is still, in good working order. It was provided with propelling engines, and was altogether designed as a sea-going boat. The present vessel is not intended for rough water. It is to be used exclusively on the Mamoudieh Canal, to protect the cotton warehouses which line its banks. It is built of steel, 60 feet long, and 10 feet 6 inches beam. It is flat-bottomed, and when in full working order has a draught of only 18 inches. The boiler is vertical, and the working pressure 100 pounds. The engine is of the firm's usual pattern, with two steam cylinders, and a pair of double-acting gun-metal pumps. The water first flows into a tank, through suction inlets on either side of the vessel. These inlets are fitted with strainers to prevent the inflow of grit; and when it is advisable, on account of the boat being close to the bank, either of them can be closed. The supply pipes of the pumps draw from these tanks instead of direct from the canal. The capacity is 2,000 gallons per minute, and a single jet can be thrown to a height of 200 feet.

The most interesting feature about the vessel is the simplicity of its means of propulsion. There is no screw, no separate propelling engines—it is driven by the fire pumps. The water raised by the pumps is ejected through a 1½-inch nozzle, placed amidships on either side of the vessel, and just above the water-line. By this means the boat is driven at a speed of four or five miles an hour. The position of either of these nozzles can be reversed in a second by means of small hand-wheels close to the steering wheel, and when it is desired to stop immediately the jets are directed downwards. Thus it can travel astern as easily as ahead, and by reversing one nozzle can turn in its own length.

At the trial steam was got up in ten minutes, and first one and then two 2½-inch jets were thrown. The hose was then connected to the other delivery outlets, and six jets, 1¼ inches diameter, were working simultaneously. Finally, the water was directed through the propelling nozzles, together and separately, and the vessel was maneuvered as well as the limited space in the basin allowed.

Besides the economy in doing away with separate propelling engines, screw shaft, and screw, the saving of weight enables a smaller vessel to be used without increasing the draught. But the great advantage, specially for a country like Egypt, is that there are fewer working parts to get out of order. We shall expect to hear of more vessels of this type being built for use on canals and rivers, both in England and abroad.—*The Engineer* (London).

I recently heard two men talking on a ferryboat about their experience in a jobbing shop. "Last week," said one, "the Old Man came to me and said a mistake had been made in ordering pulleys for a customer, and seven of them had to be rebored and that the reboring couldn't be charged up in the bill. He asked me if I couldn't rush them. I rebored those pulleys," he continued, "in half the time that would ordinarily be required. This morning, from sheer stupidity, I bored a pulley one-eighth of an inch too large. The pulley wasn't spoiled, but it must be bushed, which would cost an hour's time. Then the Old Man told me I ought to pay for the time required for bushing it." Somehow the two occurrences did not seem to consist.

All over the country may be found cities that, having given the overhead trolley system of electric propulsion of street cars pretty complete control of the streets, are trying to restrict their operations in the interest of safety. It seems to be practically impossible to do so. In a city not far from New York cars frequently run at a speed of 20 miles an hour, according to best knowledge and belief. But who could testify to that speed in a way to satisfy a court of justice? Every electric car should be provided with an indicator, from which its speed at any time can be read, and, if necessary, the speed should be registered. In no other way is it likely to be kept down to the safety limit.

A great deal of attention has been given to the development of petroleum fields in India, but the opinion appears to be strong that they do not amount to much in competition with those of the United States and Russia.

It seems rather probable that if a bridge is built across the Hudson River at New York, it will be without a central pier, which, we think, will be better than blocking nature's highway by masonry.

Gravity System for Handling Coal.

ABSTRACT OF A PAPER BY TYLER CALHOUN, SUPT. WHITWELL COLLIERY OF THE TENN. COAL, IRON & R. R. CO., PRESENTED AT THE MEETING OF THE ENGINEERING ASSOCIATION OF THE SOUTH, NASHVILLE, TENN., FEBRUARY 8, 1894.

ABSTRACT BY WALTER G. KIRKPATRICK.

At the Thomas Mines, Whitwell, Tenn., the necessity for much expensive machinery has been obviated by a gravity system for handling the coal, draining the mines, etc. The "Sewanee" seam, which is worked here, averages 3 feet in thickness and lies nearly horizontally under many square miles of the Cumberland Plateau, cropping out for over 50 miles along the face of the mountains on the west side of the Sequachee Valley. Thomas mines are 1,100 feet above and one mile distant from the tracks of the N. C. & St. L. R. R., while the mountain extends 300 or 400 feet above the mines. Mule traction is used for mine haulage, the average haul being ¾ mile, and the output is 800 to 1,000 tons per day. Mine cars hold one ton each, and the gauge of the track is 26 inches. At the mines the work of getting the cars to and from the tipples and dumping them is done mostly by gravity.

From these tipples the coal is carried to the railroad chute by an incline operated entirely by gravity. The total length of the incline is 4,700 feet and its rise 1,035 feet; the maximum grade is 46 per cent. and the minimum grade 14 per cent.; the track is of the 3-rail type, with a 4-rail parting at the middle, where the cars going up meet those going down; 30-pound steel rails; gauge, 4 feet. At each "trip" two cars, 5½ tons coal each, go down, both fastened to the end of a 1¼-inch Hewitt interlocked wire rope, which passes over 8-inch cast-iron rollers, spaced 40 feet apart, and is wound 3½ turns around each of two 7-foot drums at the top of the incline; at the other end of the rope two empty cars are drawn up, as the two loaded ones go down. These cars are shaped to have horizontal tops on the slope of the incline. In addition to the ordinary couplings the cars have safety chains, which take the weight in case of accident. The cars are controlled by a powerful band hand brake at the drum, their speed being regulated by two fans, the shafts of which carry pinions that gear with spur wheels on the drum shaft, in such ratio that the resistance of the air on the fans balances with the motive power of the incline, when a speed of 1,200 feet per minute is attained. Ten trips per hour are made. At the foot of the incline the cars are uncoupled from the wire rope and run out 500 feet to the railroad chutes, dumped by dropping their bottoms and run back to the foot of the incline practically by gravity.

The coal, after leaving the incline cars, passes, by gravity, over a series of short screens, with a drop of 6 inches from each screen to the next, the screens being set on a general slope of 30 degrees, and fitted with diamond top screen bars. The "fine" coal here falls into a bin, while the rest passes into a chute, 54 feet long and lined with steel plates. Half way down this chute is another screen, with 3 inch spaces, which takes out the "nut" coal, the "lump" coal passing directly down the chute. Thus the screening and loading on railroad cars is accomplished by gravity.

The railroad tracks in the yard and on the scales are all graded for operation by gravity.

The "fine" coal passes through eyes in the bottom of the bin into 5-ton funnel-shaped cars, which are run out by gravity on tracks across the tops of the coke ovens, into which this fine coal is dropped.

For draining the mine two siphons are used, each 1,200 feet long, one 2 inches and the other 3 inches diameter, both discharging 300 feet from the summit and 25 feet below the surface of the pump. They are primed by one man without stoppage.

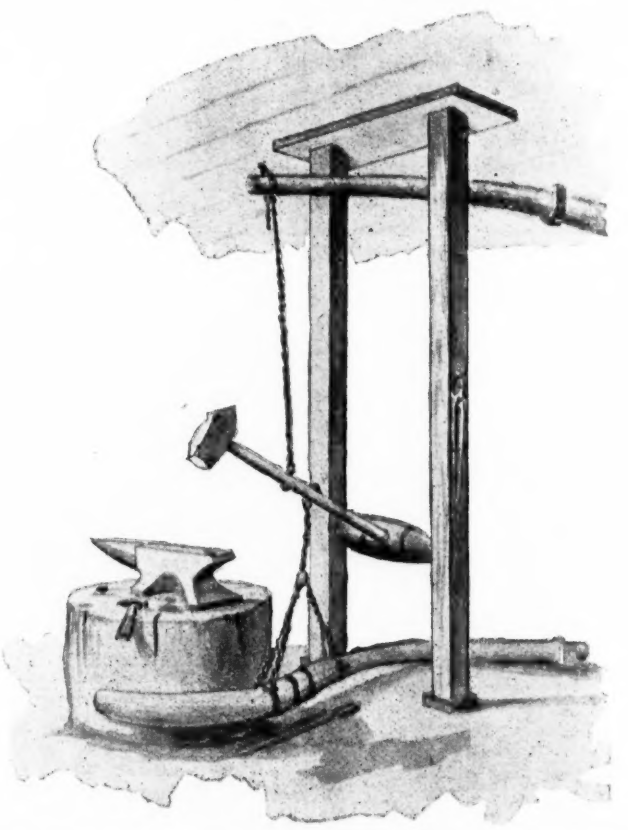
Gravity is utilized inside the mines also, in bringing down the coal; the miners undermine a few feet and allow their work to remain during the night; by morning the pressure of the roof is found to bring down the coal. In 207,094 tons output in 1893, the powder averaged one keg per ton of coal.

There is not a steam boiler nor an engine about the works. The ventilation is accomplished by furnaces. The surplus power consumed by the regulating fans, and that available from descent of the drainage water about 1,000 feet suggest further applications of the economical force of gravity.

Me Oldest Boy.

BY H. M. NORRIS.

In looking through some of the back numbers of the AMERICAN MACHINIST, Mr. Tabor's letter and sketch of "A Case of Power Transmission," in which a farmer of Brockford County, Pa., transferred a portion of the power from an old water-wheel to his house, a quarter of a mile away, "For the purpose of driving that small boy's dread, the churn," brought to mind an odd-looking relic that I came across a few years ago in an out of the way place known as Krum's Corners, about four miles northwest of Ithaca, N. Y.



One day while sailing upon Cayuga Lake with several of my classmates from Cornell, the tiller of our boat, a small sloop-rigged yacht, gave way before a sudden puff of wind. Steering by means of jib and mainsail, we were able to sail a fairly straight course to shore. Inquiring for a blacksmith (the tiller, being of wrought-iron, required welding) we were directed by one of the cottagers to Jonathan Krum, of Krum's Corners, about two miles west of the lake. Shouldering the broken pieces we wended our way to the corners, where we found the smith seated in the doorway of his forge.

After stating our case I asked if he had any one to help him, as I thought the job rather unhandy for one man.

"Yes," he answered, "I have me oldest boy."

Not seeing any one in the shop, I asked: "Does your boy live far from here?"

"No," was the smiling reply, "he lives here, 'n he's always 'round when there's a bit of work ter do. He's a good, strong boy, too, 'n in th' 47 years he's been a-helpin' me, he's never hit a false blow. But come in 'n I'll make yer 'quainted with 'im."

Leading the way to his anvil he duly presented us to his "boy," which proved to be a 20 pound trip-hammer rigged up after the manner shown in the sketch.

"The reason that I call 'im "Me oldest boy,' he continued with a great deal of pride, and not a little affection, "is because it's me first invention. I built it in '45, 'n its bin a-workin' away like a good 'un ever since."

It was indeed a novel and apparently clumsy device, but with his half-century of experience, so Mr. Krum informed us, he could hit as heavy or light a blow in as quick or slow succession as any experienced helper could for him.

It is hardly necessary to add that our tiller was well repaired.

Traction Engines.

BY E. WILLIAMS.

As traction engines are not praised nor criticised to as great an extent as other forms of steam engines, either by trade journals or engineering societies, mechanics generally are not as well posted on what has been done in that particular branch of engineering as in some other branches.

Comparatively few mechanics realize the extent of its manufacture. In the past few years several thousand of these machines have been turned out in the United States, and it may be noted they are largely a Western product. Professor Sweet, in his remarks before the A. S. M. E., while speaking of the traction he saw at the World's Fair, states that compound portable engines have not appeared in this country yet; which shows that the professor, as well as some others, has not followed the procession. Compound portables were made by the John Abell Engine and Machine Works, of Toronto, Canada, along about 1880.

The first engine built by them was tandem, and later a double cylinder with cranks at right angles.

The steam, after passing from the high-pressure cylinder, was passed through a pipe in the steam space of the boiler, and superheated before entering the low-pressure cylinder. This engine, with some slight modifications applied to a traction, was exhibited by the same firm in the Canadian section of Machinery Hall at the World's Fair. The Ritchie & Dyer Co., Hamilton, Ohio, are building compound, twin-cylinder tractions, with cranks at right angles, and have been for some time. I am not aware that any other firms in America, except the two named, have built any on the compound principle. Compounding does not seem to have met with the success that would naturally be looked for, not because they are not more economical, but there are other reasons which apply to traction engines and them only.

First of which is the increased weight, which is an undesirable feature, from the fact that they are expected to draw loads where a span of horses would be taken, and a good many places where horses could not be taken.

Then comes the increased first cost, which would probably not be so much of a bugbear, if the owner of the engine furnished the fuel, which he does not, only in exceptional cases. As to their "gymnastic" features, which is only another way of speaking of their flexibility, I would refer you to the locomotives. What would they be without the flexible feature?

Locomotives do not require near as much of it as tractions. The pulling qualities of the engine alluded to by Professor Sweet may possibly have been due to the automatic cut-off governor with which it was fitted, and I think it was the only one exhibited with automatic cut-off. Tractions, like locomotives, have two types, English and American, each best adapted to its own surroundings.

The English engine is generally a two-cylinder, though not always a compound, locomotive type of boiler, is much heavier than the American, and of greater horse-power, with driving axle rigidly attached to rear of fire-box. One cylinder, a much lighter machine all around than the English, independent axles attached to each side of fire-box and supported on springs, represents the average American practice; although some firms of late have adopted the English idea of driving axle.

The steering gear is practically the same in both, essentially a worm and worm gear with drum, chains passing from drum to front axle and suitable connections for operating by hand.

Various devices have appeared from time to time for various objects in connection with traction engines, some have grown into full-fledged articles of manufacture, others have grown, withered and died a natural death, while others have done nothing more than cause a pleasant smile from some pleasant patent attorney, and help him pay his back office rent—I meant to say his back rent for his office.

Death of John Galloway.

The cable announces the death of Mr. John Galloway, of Manchester, England, who was at the head of the engineering firm which originated and were very large manufacturers of the famous Galloway boiler. This firm also built the compound engine which drove the shafting of the British section in Machinery Hall at Chicago.

We frequently—sometimes might be better—have occasion to commend what seems to us good work on the part of the members of N. A. S. E. Last year we referred to the programme of Cincinnati No. 2, of Ohio, of which Mr. William Waddell had been elected instructor. We have now at hand the programme for this year, and must say that it is the most complete thing of the kind we have ever seen. Mr. Waddell is again instructor, and the programme covers weekly meetings from January 24th to December 26th, inclusive, except a short vacation period in midsummer. The arrangement embraces lectures on subjects of general interest, and classes in mensuration and mechanical drawing, in algebra and in applied mechanics. The names of the different lecturers show that this association is able to secure the services of the very best in their respective lines. We feel like commending the example of Cincinnati No. 2 to the attention of a good many other associations.

Recently we published a statement to the effect that the loss from fire in large cities in this country was much greater per capita in this country than in Europe. It might be inferred from this that our fire departments were correspondingly less efficient. Just the reverse of this is true. The whole trouble comes from the fact that very little attention is given in this country to the class of buildings that may be erected. Nowhere in the world is the fire department so efficient as in this country.

An engineer who formerly had a good deal to do with the construction and placing of tugboat machinery, says at one time he made all the sea cocks used in his practice; but requiring one in a hurry he telegraphed to a supply dealer for it. When the bill came, the cost was considerably less than the castings cost him, and the cock was just as good as those he made. Here was room for investigation, which resulted in his finding that he had been putting in about four times as much metal as was necessary, and that it was in the interest of economy anyway to buy the cocks.

Per contra, he had been making a combination stop and check valve that cost him four times as much as it would to buy the separate articles and pipe them in. He tried the separate valves and always insisted that they cost him fifty dollars each before he satisfied the conditions demanded.

One place has been found where it seems the electric light is not sufficiently reliable. At the Mid Winter Fair in San Francisco, a man was exhibiting three trained lions, he being in the cage with them. It was in the evening, and the place was lighted by electric lights. Suddenly these lights all went out, leaving the place in darkness, when instantly the lions attacked the man and dangerously, if not fatally, wounded him before lanterns could be secured and assistance given him. A lesson might be learned from the incident, which is: that in all places where it is imperatively necessary that lights should be surely maintained, at least two distinct circuits should be used if the lighting is to be by electricity, both circuits being in constant use—each one upon half the lamps.

The finish of steam engines has undergone a rather remarkable change during the past few years. Thirty years ago a great deal of polishing was done where there was no valid reason for it. Now it is scarcely considered that polish looks well unless it is easily demonstrated that there is some good reason for it; when polishing is done it is hardly done so well—or at least so highly—as 30 years ago. Less stone finish is seen now than then. In fact, such finish is rare. Good castings are more common now than then, that is, there are more who take pride in smooth foundry work, and, undoubtedly, more molders who know how to do it, so, perhaps, it may be said that if the steam engine—and a good deal of other machinery as to that—is not polished so highly, it is really finished better.

It would be interesting and generally instructive from a purely commercial-mechanical standpoint to know just what information merchants and manufacturers ought to get from our foreign consuls as to the standing of firms in their respective localities. We mean what, if anything, are they entitled to get? We receive a great many letters in regard to this matter, and the writers have generally expected to have been able to find out something for their protection, but the universal complaint is failure to do so. What ought they to expect, if anything?

The officers of two Spanish men of-war have resigned because the vice-admiral allowed an engineer to dine at the same table with them! There is nothing like a title; what in the way of ability goes with it does not count. Seriously, we have nothing but pity for the poor fellows who believe that a few antecedent or consequent alphabetical designations give them standing in the world.

The supply of timber available for lumber purposes will be entirely exhausted within a few years. It is becoming very difficult to buy really desirable tracts of timber land now, and if the ratio of building operations during the past 20 years is kept up for the next 20, the present woods cannot be obtained. There is no section where there is any considerable extent of virgin forest, and while as yet a second cut on lands once culled is fairly profitable it is because trees are taken now that would not have been deemed worth anything a few years ago. Walnut and cherry are practically gone, the pine has been very perceptibly decreased, and the poplar is rapidly disappearing. There is no replanting done and no attention paid to improving the size and quality of the smaller growth of trees.—*St. Louis Globe Democrat.*

It would seem that after all the trouble about medals at Chicago, and the trouble about the design of a medal, that this would be about the last of such luxuries in connection with great exhibitions. Since the Paris Exhibition—and, in fact, before that time—they have ceased to be of service. The Columbian Exhibition served a useful purpose in permitting manufacturers to show what they made, and to see what others made, but the question of medals is not worth quarreling about.

Counterfeit silver dollars are in circulation in some parts of the country that contain more silver than the genuine article.

MANUFACTURES.

An electric-light plant will be put in at Greenwood, Miss.

At Laconia, N. H., the Cole Mfg. Co. is running day and night.

The Union Bicycle Works at Newton Highlands have started up.

The Mount Hope Iron Works, Somerset, Mass., have started up.

The Whitin Machine Works, Whitinsville, Mass., are employing 700 men.

The co-operative foundry at North Dighton, Mass., has resumed work.

The Hatch Cutlery Company, of Middletown, Conn., will remove to Taunton, April 1st.

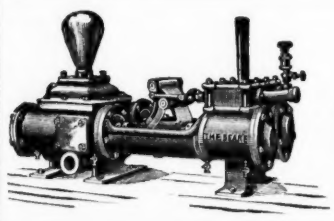
The Friction Pulley and Machine Works, Sandy Hill, N. Y., are now running night and day.

The Anniston (Ala.) Pipe and Foundry Co. have resumed operations, giving employment to 300 men.

The Alabama Manufacturing Co. has been incorporated to manufacture an improved tire-tightener at Town Creek, Ala.

The capital of the Lockwood Manufacturing Co., of South Norwalk, Conn., has recently been increased from $150,000 to $200,000.

The Syracuse (N. Y.) Machine Mfg. Co. has been incorporated to manufacture writing machines; capital, $5,000; and directors, J. Stearns and C. B. Hobbs.



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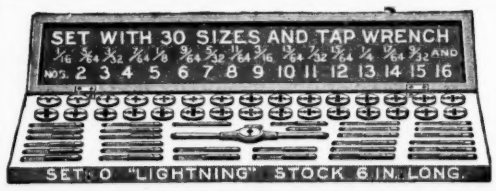

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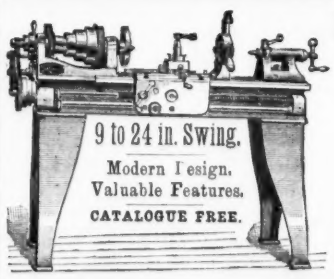

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87 MAIDEN LANE, N. Y. JERSEY CITY. CHICAGO. PHILADELPHIA. BOSTON. LONDON

The city of Griffin, Ga., has completed the purchase of the Griffin Water-works, and an electrical engineer will prepare specifications for an electric-light plant.

The Lowell (Mass.) machine shop reports more orders booked this month, thus far, than during the entire month of January. No reduction of wages is contemplated.

The extensive steel pipe works of McKee & Milson, Paterson, N. J., have resumed work with a full force of men. The works had been closed for months owing to slack trade.

Wallace & Sons, brass and bronze manufacturers, of Ansonia, Conn., who have been in the hands of a receiver, have settled with their creditors and the receiver has been discharged.

The Twin Steel Water Arch Furnace Co. has been organized at Augusta, Me. The officers are: President, Geo. W. Cook, of Boston, Mass.; treasurer, O. H. Abbott, of New Bedford, Mass.

The Connecticut Dynamo and Motor Co., of Hartford, Conn., has increased its capital from $6,000 to $8,000. The capital of the Ætna Machine Co. has been increased from $10,000 to $15,000.

The *Indianapolis* has the following: Duthe & Daggett, who manufacture fine tools from aluminum steel, are working their usual force, and three days of the week work until 9 P. M., so pressed are they with orders.

The Indianapolis Rubber Company, an enterprise but a few weeks old, is already getting well upon its feet, giving employment to forty people in the manufacture of bicycle tires and like goods.

The Sinker-Davis Company has its usual complement of men at work, 140, and is running nine hours. The president of the company says there has been a decided improvement in business of late.

The Crystal Artificial Ice Company has its new building on Wabash and Mississippi streets up, and will this week begin putting in the engine, boilers and other apparatus required to make a first-class plant.

Dean Brothers have commenced placing the machinery in their new shops on First street and the Big Four tracks that they may be ready for business when it revives, and they see some improvement in business from week to week.

The pay rolls of the Parry Manufacturing Company show that last week the company was giving employment to 744 people. These works have 14 traveling men on the road all the time, and President Parry says their sales compare favorably this month with those of 1893.

It is busy times with the Indianapolis Stamp and Chain Company. These works turn out one mile of bicycle chain a day. For some time these works were the only bicycle chain manufactory in the country, now there are four or five, but the chain the local works manufacture is so desirable that the company is experiencing no trouble in disposing of its product. One of the novel features of this establishment is that of the 100 people employed 68 are women.

The Racine Hardware Co., Racine, Wis., has purchased the plant of the Racine Hardware Manufacturing Co., and will continue the business of manufacturing steam engines and general machinery.

Mr. Robert Baden writes us to the effect that he is starting the Wolfe City Foundry and Machine Works at Wolfe City, Texas, and is prepared to do all kinds of foundry and machine work, and furnish general supplies.

Smith & Winchester, 19-37 Wendell street, Boston, Mass., issue a very complete catalogue of machinists and engineers' supplies, embracing a great variety of articles. The catalogue will be found well worth preserving.

The Thomson-Houston Co., in Lynn, Mass., has increased work, and some of the departments are very busy on account of the large orders received for railway motors. The steel foundry is running at full time with a complete force of men.

M. C. Hammett, Troy, N. Y., issues a circular of the Corey force feed lubricator for oiling all journals, etc., of a locomotive engine while running. The device consists of a reservoir located in the cab and so arranged with valves that any journal can be oiled at any time by proper manipulation.

The two large paper-mills at Burnside, East Hartford, Conn., F. R. Walker & Sons and the East Hartford Manufacturing Co., are now running on full time with a full complement of hands. The former has a contract to make 450 tons of paper for the United States internal revenue department.

Miner & Peck Manufacturing Company, of New Haven, Conn., in addition to their regular line of the Peck drop press, are about to place on the market a line of friction drop hammers. These hammers possess new and valuable features, the result of long experience and study of the subject. We will soon publish in our columns illustrations and description of the machine.

From Hartford, Conn.: The new Anchor Mill, in Windsor Locks, started recently manufacturing tissue paper, and giving employment to about 100 hands. The Torrington factories have all started on full time, including the Coe Brass Mill; Turner & Seymour, hardware manufacturers; the Union Hardware Company and C. Hotchkiss, Brothers & Co. The Hamé factory in Plainville is running nights. In Willimantic the Windham Cotton-mill and the A. G. Turner Silk-mill have both resumed work on full time.

New London, Conn., is making great efforts to get the Bath Iron Works to erect its new plant in that city. The citizens subscribed $6,000 last week for the purpose, and B. F. Mahan has offered to be one of 100 men to pay the entire cost of getting the company to locate there. Dispatches from Washington say that Secretary Herbert is in favor of the project and believes that New London would be the best place for a shipyard on account of its good harbor and its central position between New York and Boston.

Last week we published the following, but omitted the complete address. This shows an opportunity for business abroad in the direction of American hammers. Hammer makers may do well to send catalogues: "In our work-houses we feel the loss of a hammer which is put in motion by the transmission wheels, and we would be very much obliged to you if you would indicate a manufacturer in the U. S. A., which makes such hammers and other iron-working machines. We shall consider ourselves greatly obliged by rendering your services. Waiting your further favors, we are, with esteem, Direction, DER NESSELSDORFER WAGENBAU-FABRIKS-GESELLSCHAFT, NESSELSDORF, AUSTRIA."

The Philadelphia Engineering Works, Limited, Philadelphia, Pa., are in receipt of an order for one of their Corliss winding engines, from the Chamberlain Coal Co., of Pottsville, Pa., Francis A. Pocock, engineer. This winding engine has 34' steam cylinders, 60" stroke, to be operated by steam at 125 pounds pressure per square inch, generated by a battery of Stirling boilers. The engine is to be of the standard Philadelphia Corliss liberating valve gear, controlled by a sensitive governor of the "Porter" type. The engines are provided with the Stevenson link, reversed by steam gear with an oil cataract. The hoisting drums are 10 feet in diameter, 10 feet long, with powerful hand and steam brakes. The adjustment of the lift is effected by a toothed gear clutch thrown in and out with worm gearing. The main-shaft bearings are 17" in diameter by 30" long, the body of the shaft between the bearings being 19" in diameter, the central bearing being 19x30". The engine is to lift an unbalanced load of 50,000 pounds at the rate of 1,000 feet per minute. The engines and drums will weigh about 325,000 pounds.

The *Commercial Bulletin* reports the following newly organized companies: The Electric Storage and Equipment Co., Chicago, Ill.; capital, $250,000; to manufacture electrodes for storage batteries. American Structural Steel Co., Pittsburgh, Pa.; to manufacture iron and steel; incorporators, H. Sellers McKee and Murray A. Verner. At Brooklyn, N. Y., the Jamer Steam Heating Co; capital, $20,000. At Cleveland, O., the Cleveland Fork Co.; capital, $10,000; incorporators, William L. Laffer and Jacob Willard. At Rochester, N. Y., the W. P. Davis Machine Co.; capital, $25,000; incorporators, William P. Davis and Charles F. Davis. At New York, N. Y., the New York Electrical Engineering Co.; capital, $10,000. At Glen Rock, Pa., Glen Mfg. Co.; capital, $75,000; incorporators, Henry Bahn, Joseph Dise. At Defiance, O., the Wortman Co.; for manufacturing hardware specialties; incorporators, R. W. Wortman and J. W. Wortman. At Chicago, Ill., the Brownhill Co; capital, $25,000. At Chicago, Ill., McCosh Steel Co.; capital, $250,000. At Canandaigua, N.

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PROVIDENCE, R. I., U. S. A.
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VARIETIES FILES
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LECOUNT'S NEW EXPANDING MANDREL.
Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
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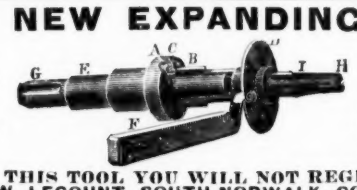

Machinist's Size.

No.		Price.
1	⅛ to 1 in.	$10
2	1 " 1½ "	14
3	1½ " 2 "	18
4 (with screws)	2 " 3 "	32
5 "	3 " 4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
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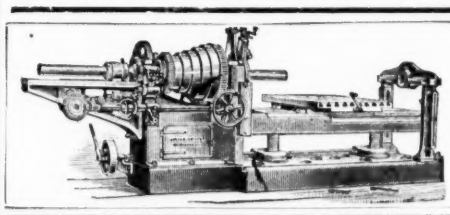
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.



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And all kinds of FINISHING. Best facilities for manufacturing small articles in Brass and Malleable Iron. Send sample for estimate.
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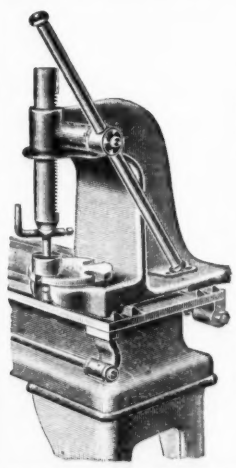

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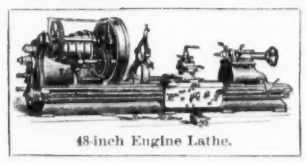
Send for Descriptive Circular.

FITCHBURG MACHINE WORKS,
MANUFACTURERS OF THE CELEBRATED
FITCHBURG MODERN ENGINE LATHE
AND OTHER METAL-WORKING MACHINES
SEND FOR CATALOGUE E.


48-inch Engine Lathe.

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Works at HAGEN, WESTPHALIA, GERMANY.
ADAPTED TOOL STEEL FOR SPECIAL USES. | SPECIAL No. 8 has no equal for use on very HARD MATERIALS. | MARKT & CO., AGENTS, 78 & 80 N. Moore St., NEW YORK.

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LARGE . . . CASTINGS
For Steam, Pumping and Sewage Engines, Loam, Dry Sand, Air Furnace Gun-Iron Castings.
Capacity of Foundry Cranes, Fifty Tons.

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FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
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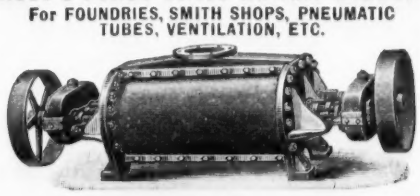
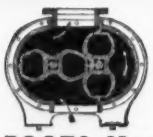
For FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.





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BEST MECHANICAL CONSTRUCTION.
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In Writing Please Mention This Paper.

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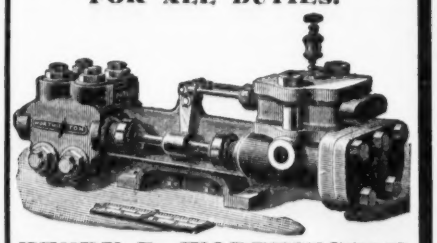
FOR ALL DUTIES.



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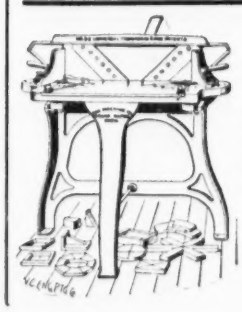
LATHES,
PLANERS,
DRILLS,
AND OTHER
IRON WORKING TOOLS.
Before ordering send us a memorandum of your requirements.
COOKE & CO.,
163 & 165 Washington St., NEW YORK.



THE NEW FOX
Universal Trimmer
is the only one that has an accurate adjustment of the gauges. Cannot be set wrong. Work must be correct. Time saved in Pattern-making and all wood-working.
CATALOGUE FREE!
FOX MACHINE CO.,
325 Nor. Front St., Grand Rapids, Mich.
135 Finsbury Pavement, London, England.

B., the Robinson Chilled Plow Co.; capital, $20,000; incorporators, E. C. Robinson and John B. Hall.

The Ousatonic Water Company and the Board of Trade recently completed arrangements with the Williams Typewriter Company, of New York, whereby the company will move its factories from Newark, N. J., to Derby. This is the concern with which negotiations have been going on some time. The Ousatonic Water Company, according to the terms of the agreement, will build a factory on the lot adjoining the factory of the Franklin Brass and Bronze Company, 125x40 feet, two stories high. They will also build at such time as the company may desire an addition to meet the demands of the business, or whatever the company may desire. The officers of the company say that this sized building will allow them to employ about 150 hands, and their employes are all skilled workmen who are a very desirable class of citizens. The company will start out with about 150 men, but if their expectations are realized they will double that number within a very few years. It is practically a new concern and the machine is said to be gaining great popularity. Its principal distinguishing feature is that the written work is constantly before the operator where it can be seen. It is claimed to be as good as the best. The Water Company began work recently on the buildings and expect to have the shops ready for occupancy by May 1st. D. S. Brinsmade said recently that if the concern reached its expectations it would prove the best concern that has ever been located by the company.—*Ansonia* (Conn.) *Sentinel.*

Machinists' Supplies and Iron.

New York, March 3, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $13.00 to $14.00; No. 2, $12.50 to $13.25; Gray Forge, $11.75 to $12.50. Southern brands of good quality are obtainable at $13.00 to $14.00 for No. 1 Foundry; $11.75 to $12.50 for No. 2, and $10.75 to $11.25 for Gray Forge.

Antimony—The market is easier and quiet. We quote L. X., 9¼c. to 9⅜c.; Cookson's, 10c. to 10½c.; Hallett's, 8¾c. to 9c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 66c. to 67c.

Copper—The demand is light and prices are lower. Lake Copper is quoted at about 9.70c. to 9.75c. Casting Copper is held at 9¼c. to 9⅜c.

Lead—The market is steady, but business is not very active. The official lead bullion is 3.10c., but 3.22½c. to 3.25c. is being asked for good commercial brands.

Spelter—The market is steady, the demand is light; 3.60c. is bid and 3.85c. asked.

Tin—The market is weak at 18.60c. to 18.65c. for prompt or March delivery. The demand is very light.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Competent draftsman wants position. Marine engines preferred. Address Holmes, Ridgway, Pa

A 1st-class gen'l mach't wishes engagem't; shop, road work or as salesm'n. C. F. Alverson, Salem, O.

Wanted—Pos. by mech. draftsman, with college education and shop exp. "J.," Am. Machinist.

Mechanical draftsman, Swede, graduate, 5 years' exp., desires position; refs. Box 32, Am. Mach.

Wanted—Situation by a young man of 21; 1½ years exp. at toolmaking. F., Am. Machinist.

Competent round die maker, with exp. on jigs wants permanent position. W., Am. Machinist.

Graduate of Univ. Mittweida des. pos. as mech. draftsman; have repres'd German firm at World's Fair. P. Planting, 2417 Cott. Gr. Ave., Chicago.

Will you export to Europe? Mech. eng. wants position to get acquainted with such machinery. C 19, American Machinist.

1st-class planer hand, with good exps. & habits, desires a steady sit. (charge preferred); 5 years in present pos., but wish a change. "L.E.," Am. Mach.

Wanted—Foremanship; exp'd. in machine tool building; 7 years as foreman; age, 31; best of refs.; the west preferred. "Chord," Am. Machinist.

Wanted—First-class machinist exp'd in putting up engines; $1,500 to right party; state experience and references. Address C., American Machinist.

Engagement desired by a practical engineer, competent to design all types of Corliss and high-speed engines and superintend the construction and erection of the same. Box 24, Am. Machinist.

Situation wanted by a practical draftsman and patternmaker, thoroughly acquainted with Corliss and high-speed engines; competent to take charge. Address Box 25, American Machinist.

Wanted—Position as supt. or master mechanic; energetic; large exp.; held position as master mechanic for ten years; unquestionable character; highest refs.; age, 39. Fulton, Am. Machinist.

Wanted—A practical molder to run a small foundry and invest from $1,000 to $2,000 in the business. Address H. H. Mason, Mt. Carmel, Illinois.

Wanted—An assistant draftsman accustomed to locomotive work; none other need apply. Apply by letter to John Rohland, care The Coxe Iron Manfg. Co., Drifton, Luzerne Co., Pa.

Stenographer—Position wanted by a first-class experienced stenographer; will furnish machine; highest references; will start at any reasonable figure. H. J. J., American Machinist.

Wanted—Foreman for erecting and machine shop by a pump company manufacturing steam pumps. A good opening for a young man of energy and experience. State age, experience, and references. Address B., American Machinist.

Asst foreman boiler maker, locomotive works, age 35, thorough mechanic, make estimates, wants position as foreman, or contract to build or rebuild boilers, tanks, reset tubes, etc.; R. R. shop pref'd; refs. A1. "Temperate," Am. Machinist.

Wanted—Situation as foreman or superintendent of machine shops; have held both positions; experienced on Corliss engines, mining & gen. mach'y; 38 years of age; 22 years' practical experience; first-class references. Address Box 4, Am. Machinist.

To correspond with parties in need of a draftsman designer; competent to design and superint'd the building of metal work'g mach. tools; special & aut. mach'y & labor-saving devices; have had successful experience in the shop, and been in charge of a drawing room. T., Amer. Machinist.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York,Clev'd,O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

For Sale—Second-hand drill presses,engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Calipers, Surface Gauges, etc. Catalogue free. Send for it. F. A. Welles, Milwaukee, Wis.

Wanted—To buy lathes and planers, 24" and up. Box 27. American Machinist.

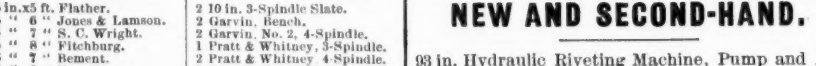
For Sale—Supply business and machine shop in Central Pennsylvania. For particulars address P. O. Box 27, Harrisburg, Pa.

Grinders' Supplies—Emery, Emery Wheels, Grinders, Knife Powders and Sharpeners, Paste & Liquid Polish, Whetstones. The Tanite Co., New York, N.Y.; Cincinnati, O., & Stroudsburg, Pa.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Wanted—By a well-known English firm, a patented engineering specialty, to manufacture and sell in England and colonies. State full particulars to "N.", care T. B. Browne's Advertising Agency, 353 -355 Canal Street, New York.

Michigan Agricultural College offers instruction in mechanical engineering—four years' course; the average expense of attendance at the college is $135 per year; the course is arranged so as to give students an opportunity to earn a portion of their expenses. Address Mechanical Department, Agricultural College P. O., Mich.



Established in 1874.

CLEVELAND TWIST DRILL CO.

COR. LAKE & KIRTLAND STS., CLEVELAND, O.

100 & 102 Reade Street, New York.
85 Queen Victoria St., London, Eng.
5 Neue Promenade, Berlin, C., Germany.

SECOND-HAND MACHINE TOOLS.

ENGINE LATHES.

1 15 in.x5 ft. Flather.
1 15 " 6 " Jones & Lamson.
2 15 " 7 " S. C. Wright.
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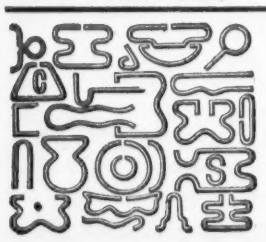

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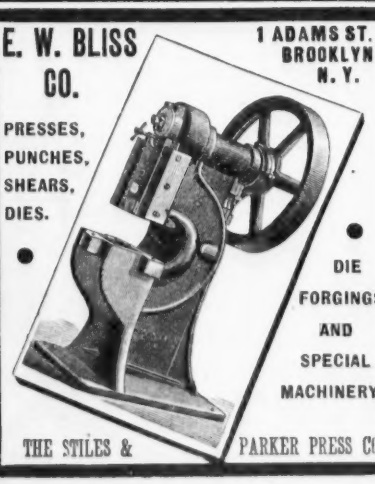

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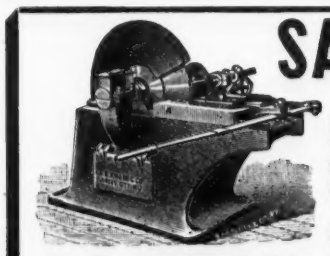

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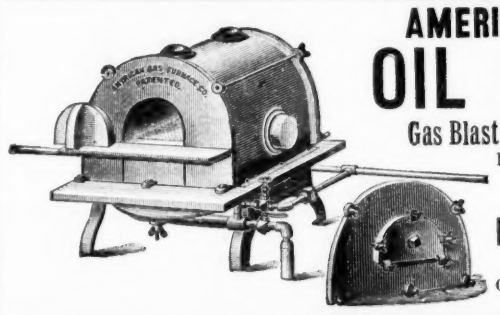

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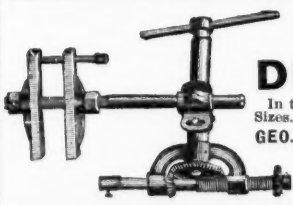

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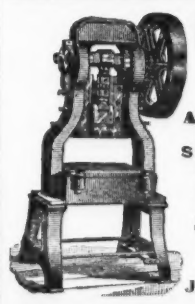

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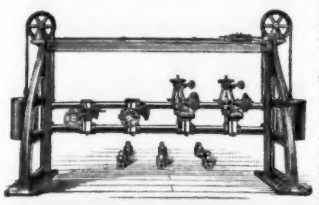

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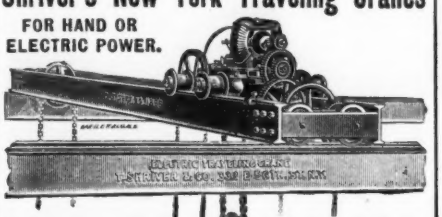

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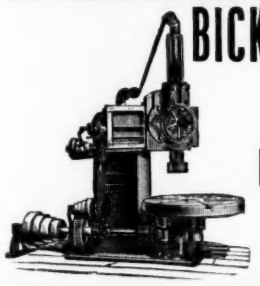

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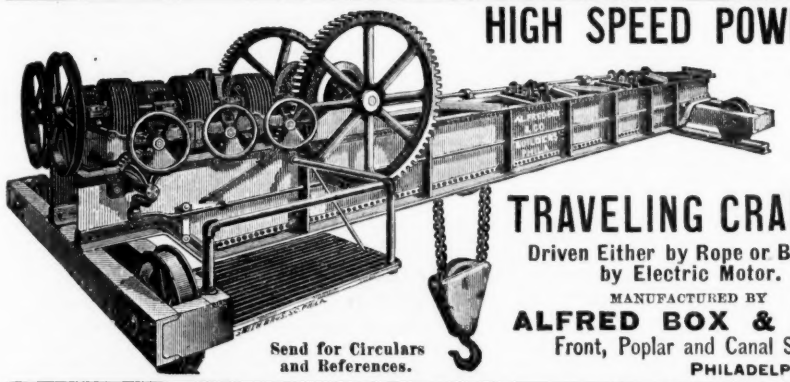

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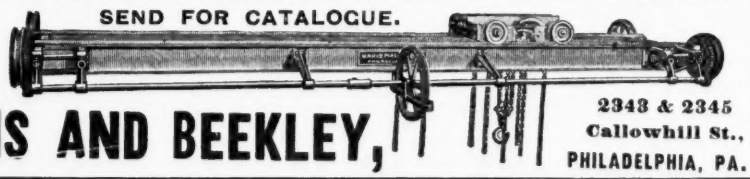

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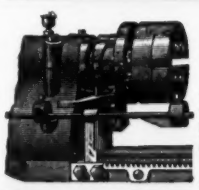

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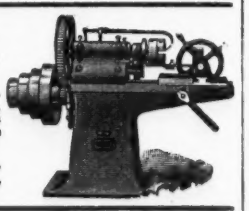

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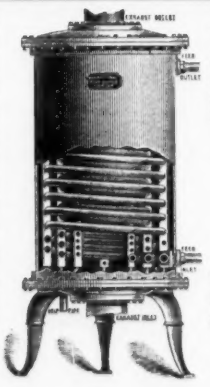

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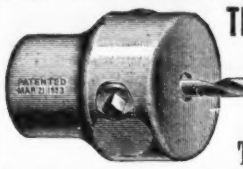

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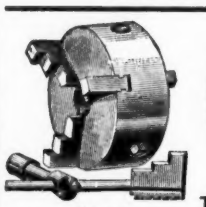

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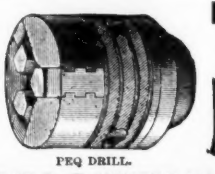

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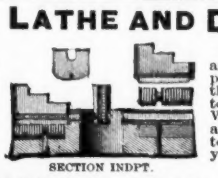

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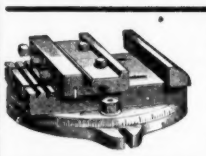

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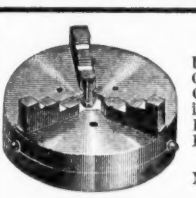

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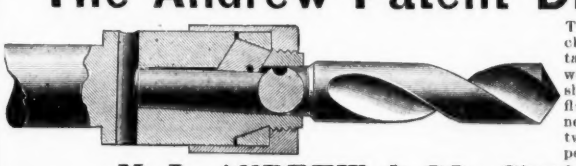

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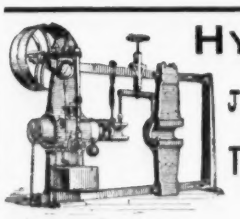

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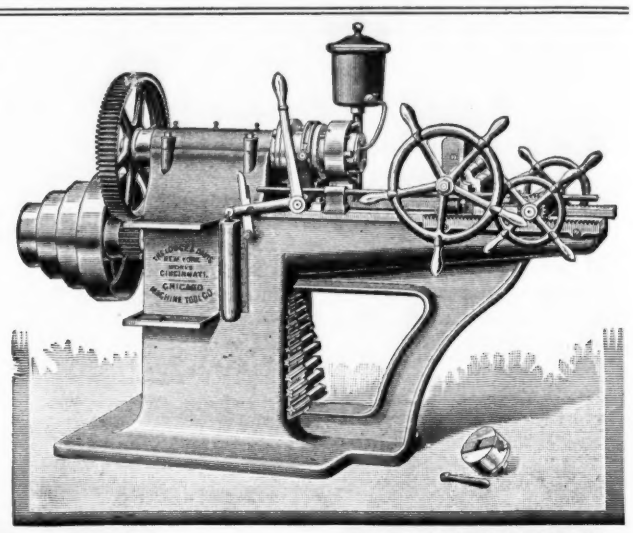

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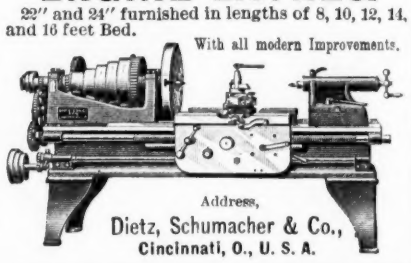

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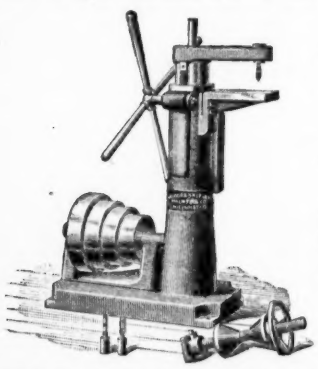

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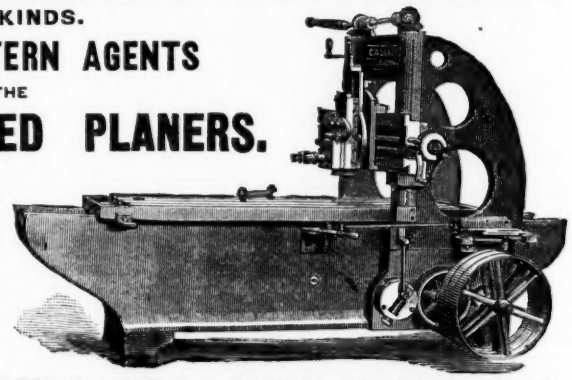

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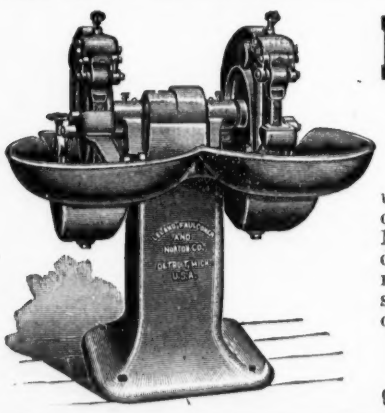

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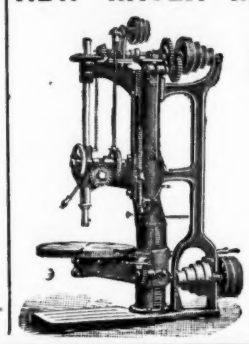

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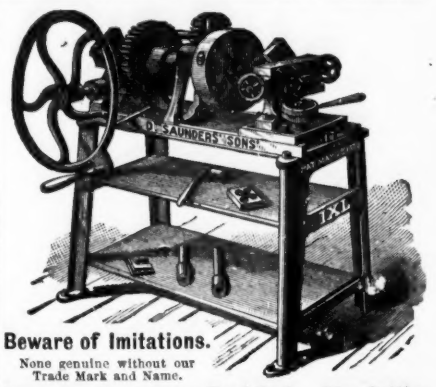

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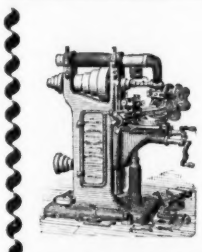

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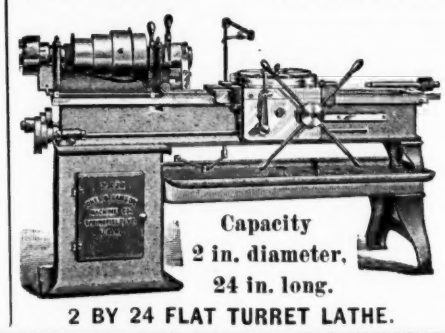

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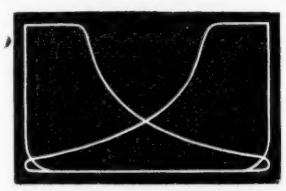

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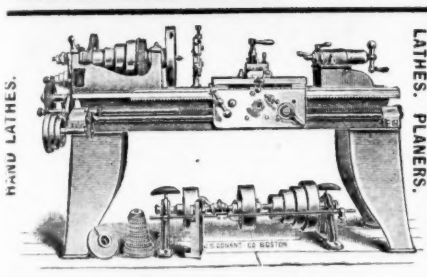

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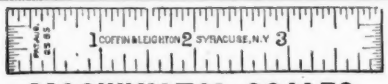

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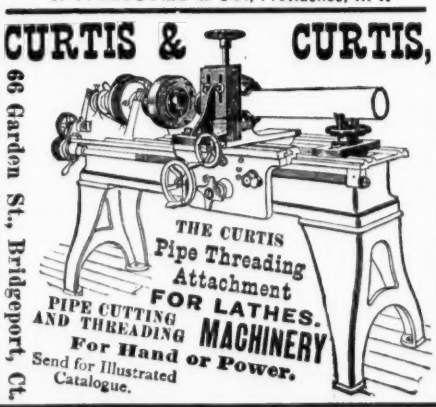

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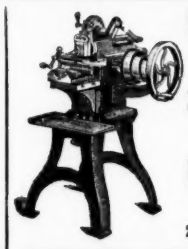

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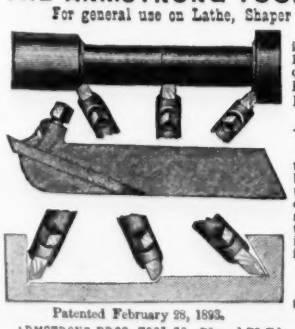

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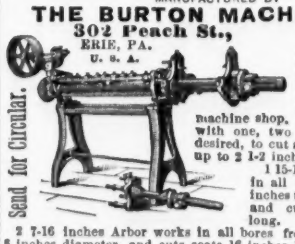

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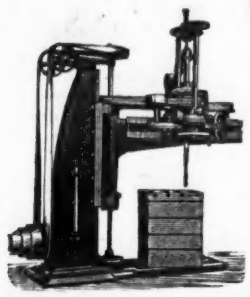

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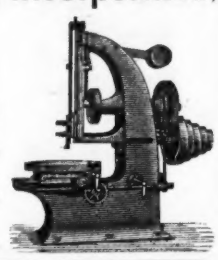

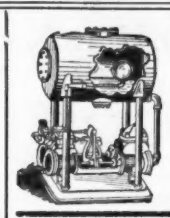

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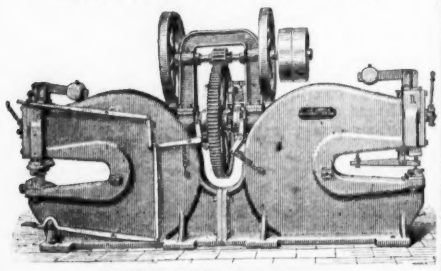

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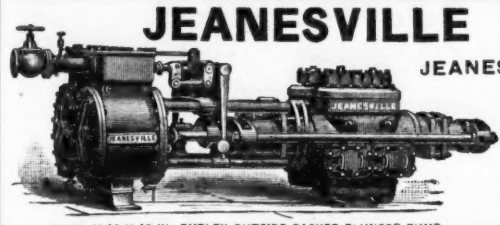

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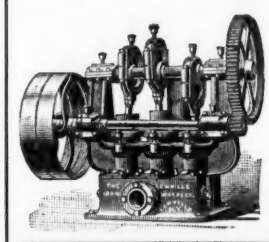

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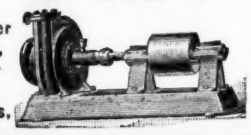

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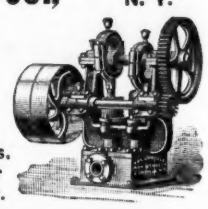

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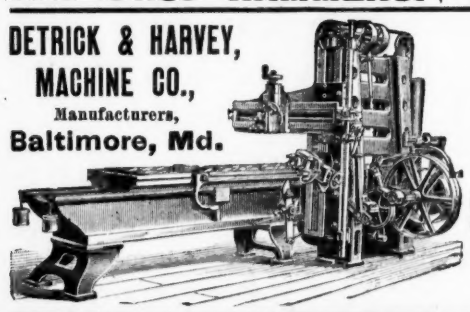

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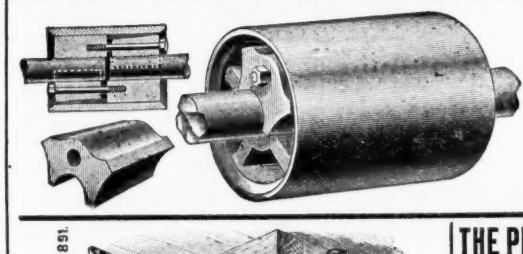

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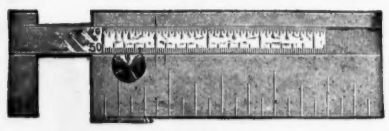

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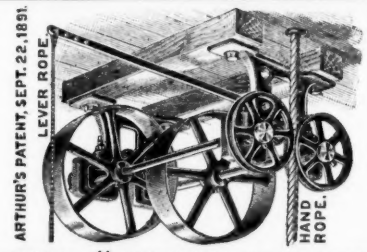

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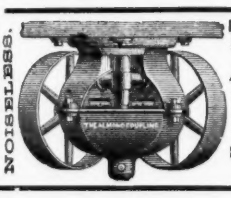

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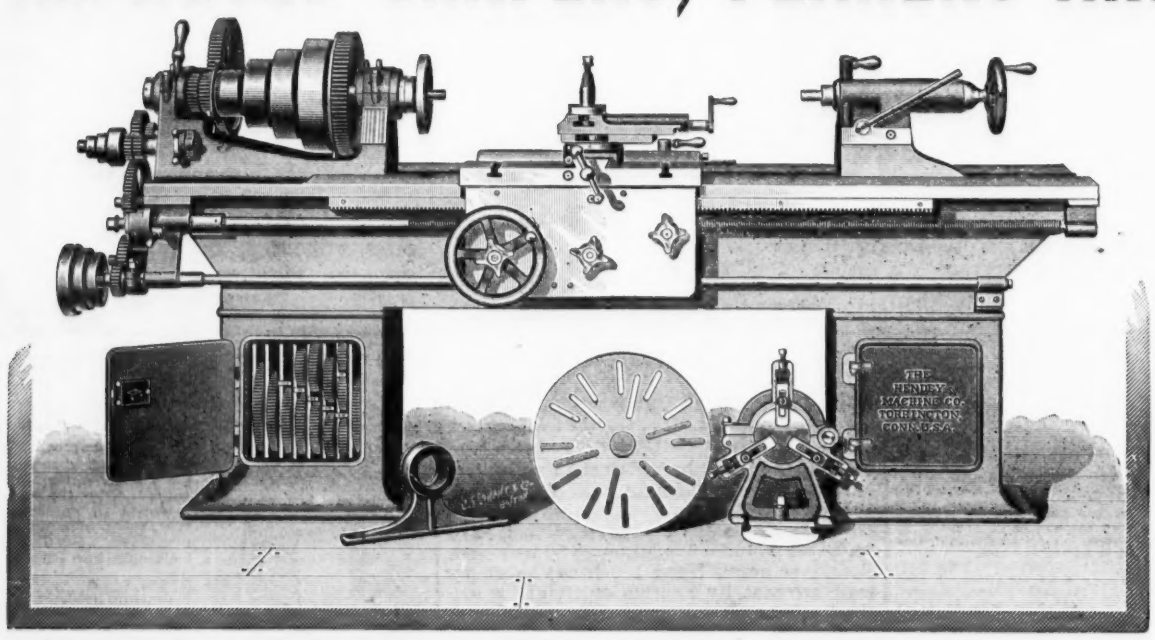

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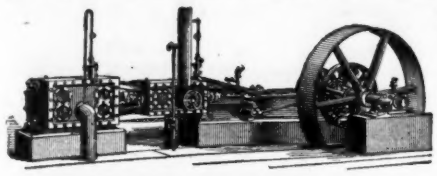

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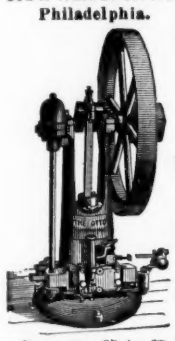

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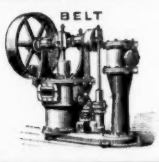

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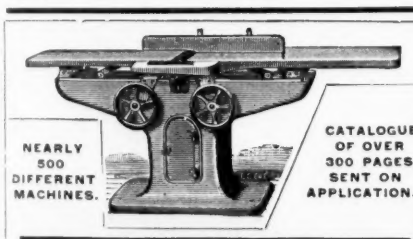

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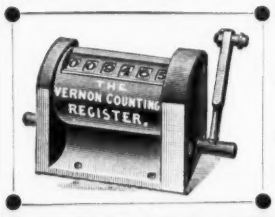

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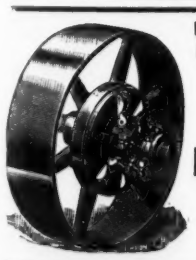

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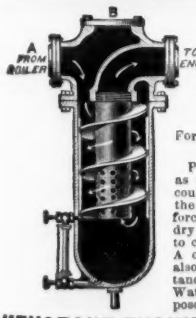

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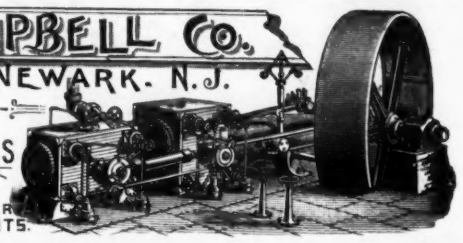

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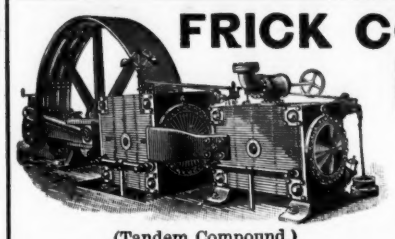

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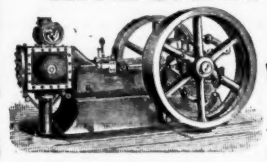

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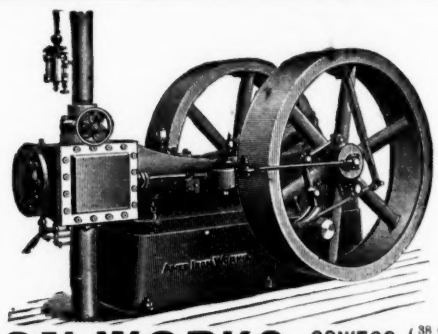

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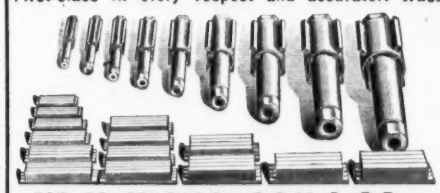

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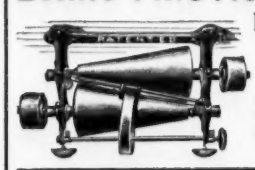

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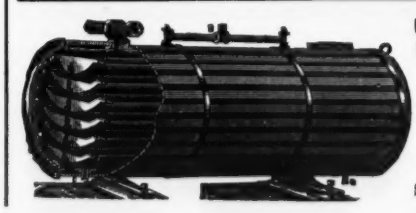

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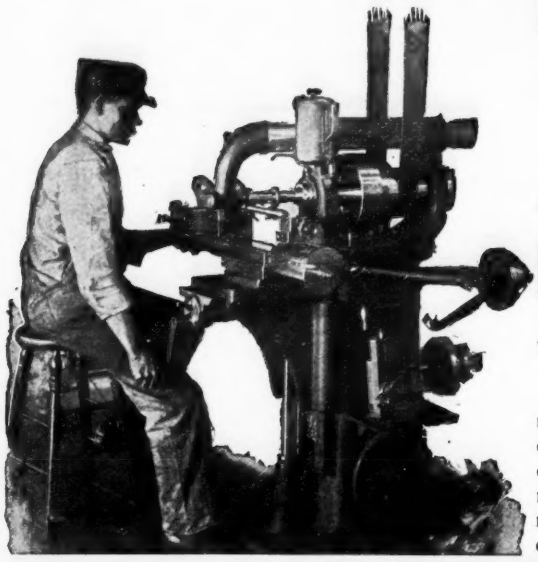

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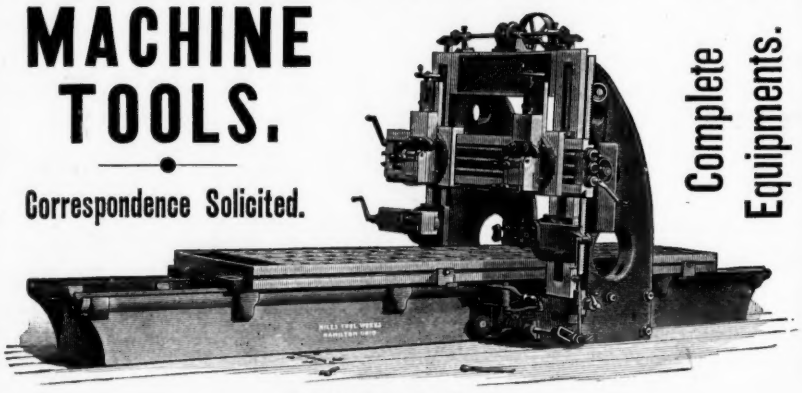

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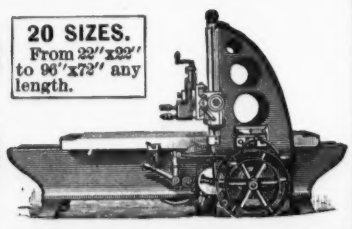

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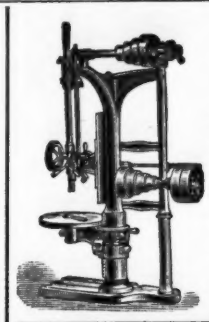

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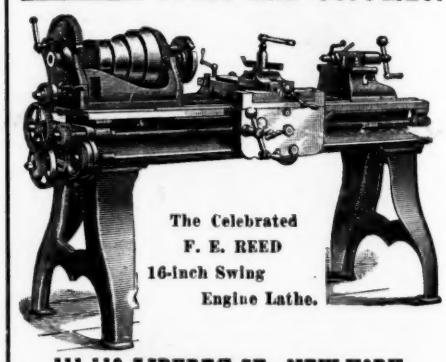

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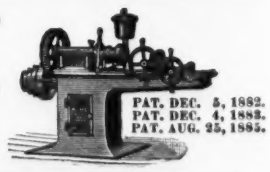

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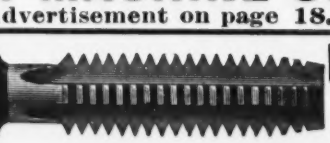

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